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गुरुकुल कांगड़ी विश्वविद्यालय हरिद्वार

THE KEŌLADEO GHANA OF BHARATPUR (RAJASTHAN)

BY

SÁLIM ALI

(*With four plates*)

One of the first acts of the newly constituted National Committee for India for Bird Preservation has been a recommendation to the Central Government to notify Keoladeo Ghana as a national bird sanctuary in order to ensure its unimpaired continuance as a breeding ground for water birds.

Keoladeo Ghana has enjoyed, and still enjoys, a reputation as a winter resort of wildfowl and a duck-shooting jheel which is perhaps second only to the Manchar Lake of Sind in pre-partition days. Unlike the Manchar, however, it has long been the private preserve of the rulers of Bharatpur; therefore, its fame is less widespread since comparatively few people have been privileged to shoot on it, chiefly as the Maharaja's guests. At the big official shoots, of which three or four used to be held each year between November and February and to which distinguished persons were invited, some very large bags were made. The more notable of these are permanently inscribed on a special kiosk erected at a central point near the jheel. The biggest ever was made on the 12th November 1938 when the then Viceroy, Lord Linlithgow, and 38 other guns accounted for no less than 4,273 duck and geese.

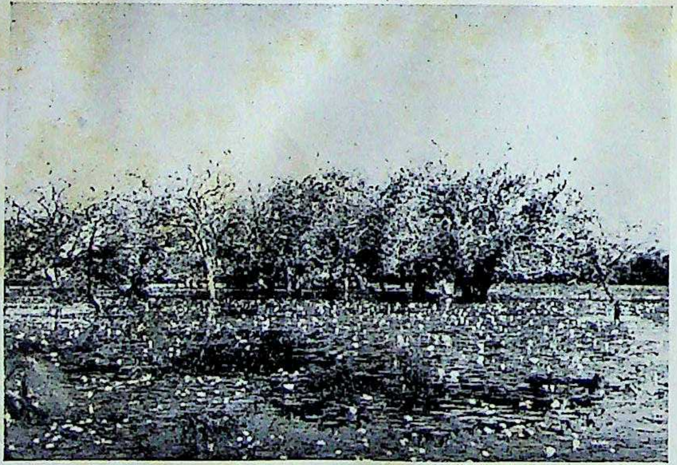
Incidentally it was on this day also that perhaps the world record for shots fired in one day by a single sportsman was made, the ex-Viceroy being reported to have loosed off no less than 1900 rounds! Even allowing for the weight and substance with which Lord Linlithgow was blest by nature, such a feat sounds truly superhuman and can seldom, if ever, have been equalled. The kiosk reveals that between 1907 and 1946 there were 19 shoots in which bags of over 2,000 duck and geese were made, and of these 5 accounted for over 3,000 birds each. As to the ethics of mass slaughter upon a scale such as this one can only hope that there are no two opinions, but the bags in themselves are a good indication of the density of the wintering wildfowl population on the Ghana after a season of good monsoon.

Some may even find comfort in the fact that with the changed political and economic conditions in India, organizing on the lavish scale necessary for these big shoots will no longer be practicable except perhaps once in a way. Indeed the present world position of ducks and geese shows such disturbing signs of rapid deterioration that every factor tending towards their preservation must be welcomed by conservationists. But in the cessation of these mammoth shoots on the Ghana and in its altered status from a rigidly protected private game preserve there is one great danger inherent which it is hoped its conversion into a national sanctuary will help to mitigate. The danger stems not so much from the direct destruction of wildfowl through over-shooting or even illicit netting or from the harassment of the breeding water birds as from the possibility of reclaiming the Ghana, ostensibly for purposes of cultivation, or from the diverting of its water supply elsewhere. Under the new order in Bharatpur, certain of the more disgruntled and less imaginative elements of the population have recently been clamouring for the jungle on the site of the Ghana to be cleared and the area to be thrown open for growing crops; or alternatively that the water from the Ajan Bund should be diverted away from the Ghana and put to better use than 'providing duck shooting facilities for the Maharaja and his friends'—a charge that is neither justified nor entirely without malice. The effect of diverting the water from Ajan Bund elsewhere, which at present goes to fill the Ghana, would of course be to ruin the place completely as a duck-shooting jheel because even in a good monsoon the water that collects in the depression is not sufficient to last through the winter months without replenishment from Ajan Bund. But the effect of clearing the Ghana of jungle and draining its bed, would be far more disastrous from the bird preservation point of view. It would mean the devastation of the nesting grounds of a congregation of water birds the like of which certainly does not exist anywhere else in India, and perhaps in few places in the world.

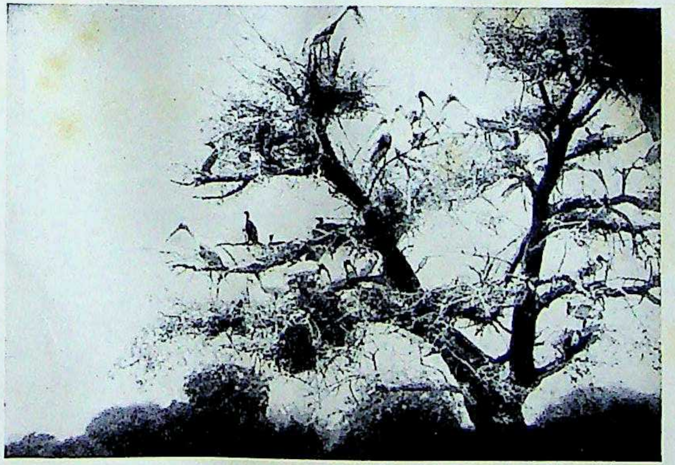
To appreciate this danger properly it is necessary to understand the topography and circumstances.

The total area covered by Keoladeo Ghana is 17,455 bighas equivalent to about 7,000 acres. Just before the onset of the monsoon the Ghana presents the appearance of an expansive park-like basin covered with patches of medium-sized trees and shrubs of babul (*Acacia arabica*), Kandi (*Prosopis spicigera*), Peeloo (*Salvadora persica* and *S. oleoides*), wild caper (*Capparis aphylla*) and other species characteristic of a semi-arid biotope. Here and there stand enormous single trees or groves of the spreading, verdant Kadamb (*Acanthocephalus kadamba*). The parched ground is scantily covered with close-cropped grass which is lush when the water first dries on the advent of the hot weather and provides good grazing for the cattle of Bharatpur city and environs. In as much as this is the only grazing available in the neighbourhood for the cattle which supply milk to Bharatpur city, its maintenance seems essential even from the economic angle. The grazing fees derived from the Ghana total about Rs. 10,500 per annum. In years of normal rainfall (average *ca.* 27 inches) the depression gets filled between July and September and becomes a shallow lake in which reeds, sedges, lotus and a variety of floating aquatic

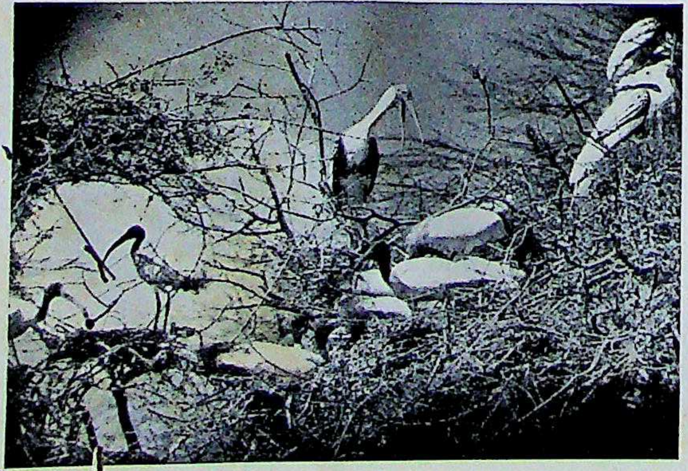
KEOLADEO GHANA, BHARATPUR



General view of a section of the Heronry



Cormorants, White Ibises and Painted Storks



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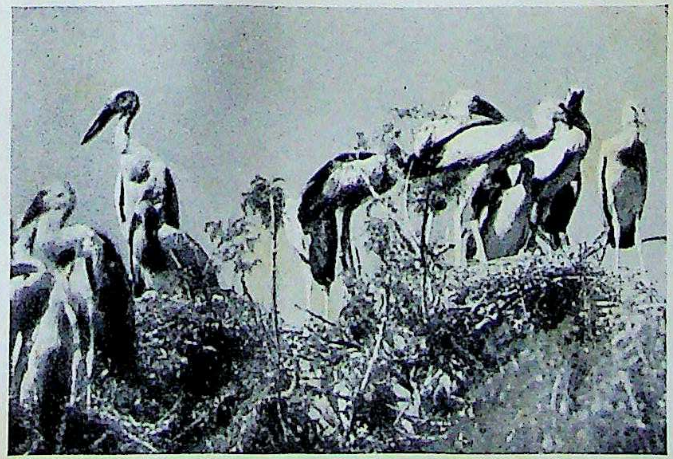

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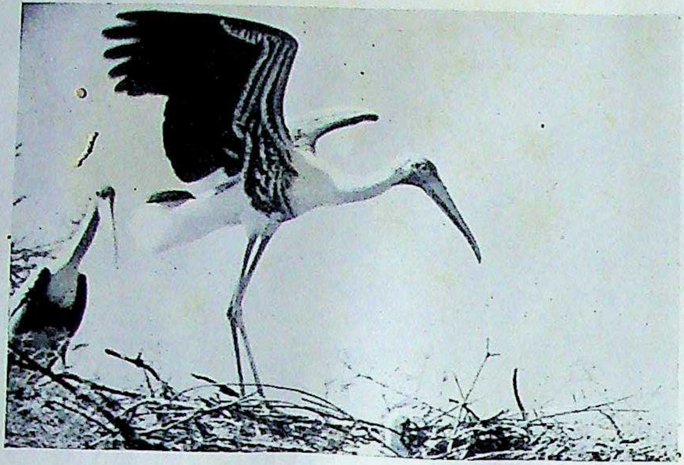
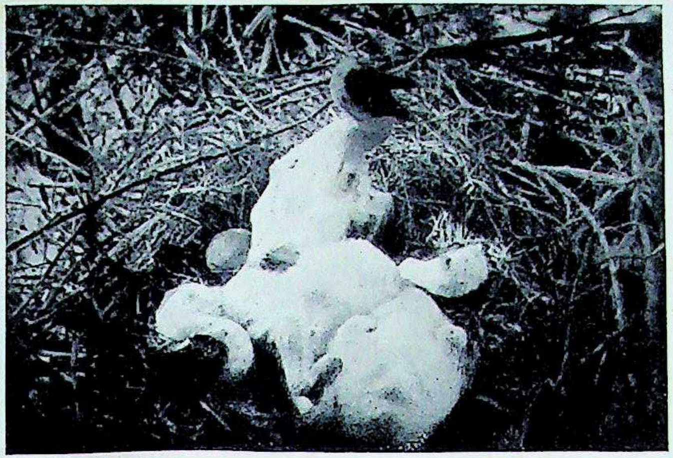
Openbilled Storks, adults and young

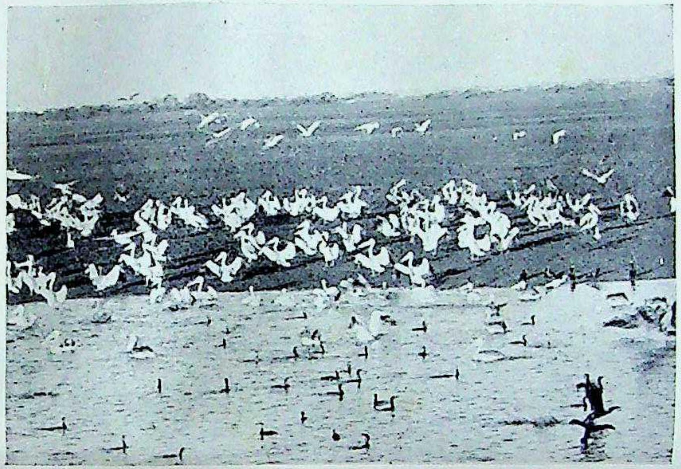
KEOLADEO GHANA, BHARATPUR



Painted Stork arriving at nest



Downy chicks of Painted Stork feigning death



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vegetation abounds. Owing to the nature of the soil, the Ghana begins to dry up rapidly after the monsoon, and were it not for the additional water let into it from the inundations of the rivers Gambira and Banganga which are impounded on arable land above by means of an artificial dam called Ajan Bund, it would become too dry in the winter months to attract wildfowl in the quantities it now does.

Under normal conditions the level of the water collected above Ajan Bund is high enough to permit, or in fact necessitate, its being sluiced into the Ghana by stages after about 15th September. Thus by the middle of October all this water has drained into the Ghana making the land above the dam available for ploughing and sowing rabi crops such as wheat and gram. This tail water, added to the partial natural inundation by the monsoon, is really what transforms the basin into the expansive shallow lake and makes the Ghana the duck-shooting paradise it is in winter.

For the non-shooting bird lover the real charm of Keoladeo Ghana lies in the vast variety of masses upon masses of water birds that frequent the lake, particularly during the breeding season, between July and November. A visit to this gigantic heronry at the appropriate time of year and in a season of normal rainfall is, for an ornithologist, an experience that he is not likely to forget. There is no doubt that with suitable facilities for visitors, both pure sightseers and scientific investigators and bird photographers, the place has potentialities of the highest order.

Already by the end of July or in early August the partially submerged trees in the Ghana begin to be appropriated by the various species of water birds, and they soon become covered with masses of twig platforms of varying sizes in disorderly but close-packed tiers. The large kadamb trees are chiefly patronized by Painted Storks and Cormorants, while the babul, kandi and others are occupied by Open-billed Storks, Egrets (*Egretta alba, E. intermedia, E. garzetta* and *Bubulcus ibis*), Cormorants (*Phalacrocorax carbo, P. javanicus* and *P. fuscicollis*), Darters (*Anhinga melanogaster*), White Ibises (*Threskiornis melanocephalus*) and Spoonbills (*Platalea leucorodia*). Although in many cases nests of a particular species predominate in a certain tree, there is no hard and fast segregation, and nests of 4 or 5 different species may often be all in the same tree, perhaps several of each kind cheek by jowl and touching one another. After an experience of this kind, one wonders how many of the neatly labelled eggs seen in collections, e.g. of egrets, are of really undoubted authenticity as to species. It is usual to find nests of all 3 egrets along with those of cormorants, darters and white ibises packed in a single tree. On approach of the collector all the incubating birds fly off; the twig nests in all cases are similar shallow platforms, and the eggs of the various species are also hard to tell definitely from one another. Under the circumstances unless nests are carefully marked down beforehand, while the owners are actually sitting on them, I found it quite impossible to be entirely certain about the specific identity of eggs taken from these mixed colonies.

The tops of some of the lofty kadamb trees scattered solitarily on the edge of the jheel are patronized by the massive stick nests—disused at this season—of Pallas's Fishing Eagle (*Haliaëtus leucoryphus*). From here the birds keep a close watch over the surroundings for prey. Coots, which winter on the Ghana in great abundance, form an important food item of this eagle.

The enormous ancient peepal trees which are dotted here and there, particularly in the neighbourhood of Ajan Bund, are favourite sites for the non-colonial nests of the Blacknecked Stork (*Xenorhynchus asiaticus*).

It has always puzzled ornithologists as to what happens to these multitudes of normally sedentary birds in years of bad monsoon when the Ghana remains dry and conditions for nesting are unfavourable. Do they spread themselves out far and wide in search of alternative nesting grounds? or do they contrive to skip a season without reproduction? These are questions to which satisfactory answers can only be found by marking the birds on a sufficiently large scale. The only results we have so far had from a rather limited ringing of young White Ibises one year was that one of the marked birds was again observed on the Ghana a year later. Whether it was breeding at the time or not could not be ascertained.

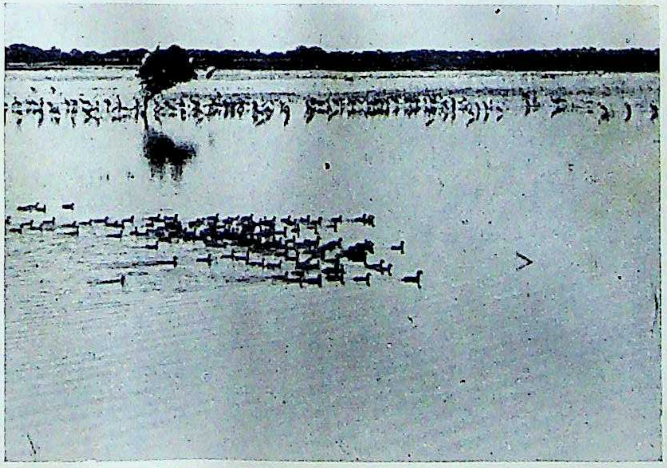
No sooner have the first showers of the monsoon filled the ditches and hollows in the bed of the Ghana than the water birds begin to move in, evidently over considerable distances of the surrounding countryside in many instances, and the scene is soon transformed into one of bustling activity. The birds lose no time in staking out their claims for nesting sites, and building operations presently become intense. There is much rivalry and jockeying for coveted situations, and a great deal of squabbling and noise prevails. Besides the species named, there are Paddy Birds (*Ardeola grayii*), Night Herons (*Nycticorax nycticorax*), Grey Herons (*Ardea cinerea*) and Purple Herons (*Ardea purpurea*) settling in the tree-tops, while Purple Moorhens (*Porphyrio poliocephalus*), Gallinules (*Gallinula chloropus*), Whitebreasted Waterhens (*Amaurornis phoenicurus*) and Dabchicks (*Podiceps ruficollis*) are competing for sites on the weed-covered water below, and in the bushes and reedbeds along the edge. All the time the distant sonorous trumpeting of the Sarus Crane is on the air as pairs stride along sedately on the squelchy grassland or indulge in their spectacular prancing and leaping 'dancing dervish' courtship displays. In years of good monsoon the Sarus nests freely on the edge of the Ghana or on grassy islets in the midst of shallow water or marshes, and while one bird is sitting on the eggs its mate is invariably keeping guard nearby to give warning of suspicious intruders or to chase off a stray dog or cow venturing into unwelcome proximity of the nest.

Twig platforms bedeck the partially submerged trees in close-packed disorderly tiers. To the observer it is a source of unceasing wonder how the birds ever manage to sort out their own nests amongst this welter of jostling and confusion. After the young have hatched out and are sufficiently grown to leave the nest and to clamber helter skelter amongst the surrounding branches, the confusion becomes worse confounded. How parents then ever recognize their own offspring is indeed a mystery, but it is significant that feeding of the chicks is only done on the nest so that the wandering brood must always return to this centre in order to obtain the food which the parents bring. It would seem therefore that the important thing is for the birds, both adults and young, to recognize their nest rather than one another.

KEOLADEO GHANA, BHARATPUR

KEOLADEO GHANA, BHARATPUR

Cormorants fishing



Coots

Blackbuck in the Ghana environs

Author

Sarus Crane and nest

KEOLADEO GHANA, BHARATPUR

Pond Heron (*Ardeola grayii*) and (swimming) Darter (*Anhinga melanogaster*)

W. T. Loke

Sarus Cranes (*Antigone antigone*) being disturbed from nest by grazing buffalo

The vast quantities of food—mostly fish, frogs, snails and water beetles—needed to sustain a bird concentration of this magnitude for a period ranging over several months, in which voracious youngsters have, moreover, to be catered for, is a source of interesting but somewhat bewildering speculation. It has been found impossible to make even a reasonably accurate census of the breeding bird population of the Ghana as a whole, since no technique of counting of which I am aware seems applicable to the conditions that obtain. However, a very rough and ready count I made one season on a small section of the lake occupied chiefly, but not exclusively, by Painted Storks will suffice to indicate the enormous quantities of food involved, and point to the abounding richness of the Ghana as a source of fish supply.

In this census area of roughly one square mile it was conservatively estimated that 2-3,000 pairs of Painted Storks were feeding nest young of varying ages but mostly well grown, in the last week of October (1942). A generous margin of error was allowed for, so that it may well be that the actual number was nearer 4,000 pairs. Every tree standing in the water in this well-wooded section, large or small, was crowded out with nests of Painted Storks in addition to countless others, chiefly of White Ibises and Cormorants. The din of the young birds' expectant clamour for food was incessant, and it became deafening on the return of the parents with food. The normal procedure is for a parent to alight on the edge of the untidy nest or upon an adjacent branch, apparently quite heedless of the insistent begging of the young excitedly shaking their heads from side to side to the accompaniment of a strident scraping double note. After a few moments of this detached 'meditation', as if overwhelmed by a sudden fit of violent sea-sickness, the parent aims its bill perpendicularly down into the nest and disgorges anything from 4 to 8 fishes, one after another, lavishly lubricated by a disgusting looking slime. These are quickly gobbled up from the nest floor by the hungry youngsters, some of the greedier and more impatient ones even thrusting their bills up into the parent's gullet and tugging at the food to speed it on its way.

The appetite of all young birds is phenomenally healthy, but that of the Painted Storks quite amazingly so. When a fully fed fledgling on the nest is handled, its immediate reaction is to disgorge all the food it has lately guzzled. It thereafter lays itself down on the bottom of the nest, arranges itself in pitiable contortions and does its best to pretend it is in the last agony of death. This obliging habit makes it possible for the investigator to gain some idea of its food requirements. Frequently I found 5 or 6 fish thus cast up by the chicks, each maybe 3 or 4 inches in length and weighing in the aggregate between ½ and ¾ lb. Upon this data an interesting problem of simple arithmetic can be based. Assuming that each nest holds only two young—actually 3 is the commoner number and 4 not unusual—and that they are fed no more than twice a day, it means that 2 to 3 lb. of fish are needed per nest per day. Therefore for the, say, 2,000 nests in this section of the Ghana the daily requirement worked out to 4 to 6 thousand lb. In addition to young, however, there were the parents—4,000 of them—who presumably needed at least the same quantity for their own sustenance. Thus this breeding colony of Painted Storks alone required 8-12,000 lb. of fish per day, or 3½ to 5½ tons, and that at least for 30 or 40 days. Counting it only as a round 3 tons per day and that only for 90 days in order to simplify our arithmetic, we still arrive at the astounding total of 90 tons of fish needed to sustain a fraction of the total breeding population of a single species on the Ghana! And this, leaving out of count the masses of other fish-eating birds, of which the cormorants in particular are well known to be every bit as voracious as they were plentiful and prolific.

As a showplace for nature-minded tourists and visitors to India, and as a centre for scientific investigations on the biology of water birds, the Keoladeo Ghana of Bharatpur merits the highest rank. It is easily accessible by road and rail, being under 150 miles from Delhi and only about 30 from Agra. It is hoped that turning it into a permanent national bird sanctuary will ensure its unimpaired continuance and save it from the extinction with which it is threatened through questionable schemes for clearing the jungle and draining off the water in order to grow more food.

Finally, it may be stated that in my opinion properly regulated shooting of wildfowl on the Ghana in winter by sportsmen of the right type is not likely to prove detrimental to the aims and objects of this particular sanctuary, and it seems unnecessary to ban shooting altogether. At present the shooting rights are vested in His Highness the Maharaja of Bharatpur, and restricted permits are also issued by the Rajasthan Government to special State guests to shoot on the lake.

Since the merging of Bharatpur State into Rajasthan, the area has been treated as a Reserved Forest under the Divisional Forest Officer, Bharatpur. It is patrolled in the routine manner by forest guards whose duty is to prevent illicit felling or lopping of trees and killing of birds and animals. The right to fell and remove dead trees and to collect dead twigs, etc., for firewood is auctioned annually by the Forest Department.

The strengthening of the existing organisation by the addition of a few extra guards, more vigilant overall supervision, and tightening up of current restrictions would probably meet the case as far as the safety of the birds and animals is concerned. The vital need, however, is to ensure that under no circumstances shall hasty schemes of draining or deforestation be undertaken which are likely to alter the ecology of the Ghana and jeopardise the very existence of this unique natural feature.

CHARACTERISTIC COLOURATION OF JUVENILE SPECIMENS OF *LABEO* (*MORULIUS*) *ANGRA* WITH NOTES ON GROWTH[1]

BY

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(*With two text figures*)

INTRODUCTION

Labeo (*Morulius*) *angra* (Ham.) is fairly common in the Mahanadi River where it breeds along with other carps during the monsoon months, July-August. Hatchlings and young fry are occasionally caught along with those of major carps from the river, though it has not yet been possible to identify and isolate them during these early stages. Several advanced fry and early fingerlings were collected at Cuttack from experimental nursery ponds which were stocked with a mixed collection of early carp fry. These specimens show some resemblance to corresponding stages of *Labeo calbasu* and the local fish farmers also generally identify them with the latter species. *L. angra* is known to occur in Assam, Bengal and Orissa in India.[2] It does not generally exceed 8-9 inches in length.

Since nothing is so far known about the life-history of this species and since it is necessary to distinguish this relatively minor carp from its larger congener, *L. calbasu*, a brief description of the juvenile specimens and their distinguishing characters from *L. calbasu* are given in this note. A post-larval specimen which was obtained from Assam is also briefly described. Several specimens were reared in cement cisterns and nursery ponds at Cuttack for a period of about 11 months and their growth during different stages is also reported in this communication.

POST-LARVAL STAGE

A single specimen, 12.8 mm. long, was obtained on 5-6-1951 from an isolated, shallow pool in the Raomari Bheel, Gauhati, Assam. A dark, blotch-like pigment spot at the tip of the caudal peduncle and smaller concentrations of chromatophores on the body, one each at the base of the dorsal and anal fins, are characteristic of this specimen.

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[1] Published with the kind permission of the Chief Research Officer, Central Inland Fisheries Research Station.

[2] Day, F. (1889): Fauna of British India, Fishes, Vol. 1, pp. 267-268.

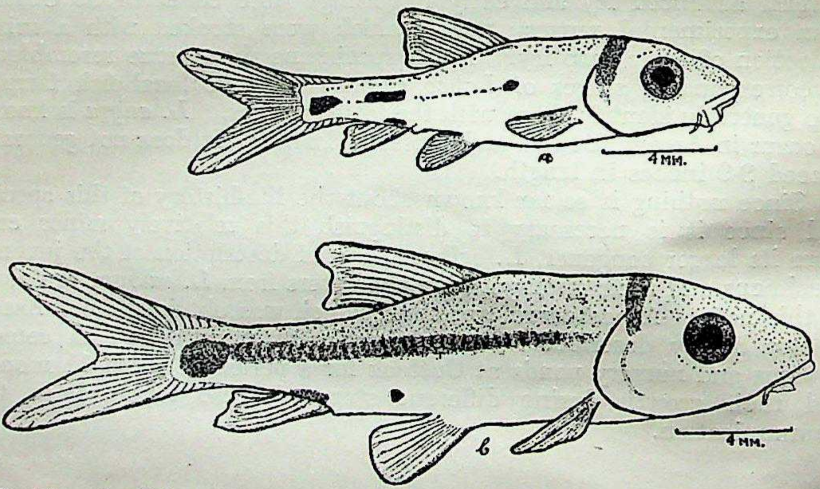
A few chromatophores are present over the nape, extending down to the operculum. There is no pigment on any of the fins. Maxillary barbels have appeared. The dorsal, anal and caudal fins are differentiated but the ventral fins are rudimentary.

Juvenile Stages

Stage I: 20.0 mm. long: (Fig. 1*a*)

Body is pale yellowish in colour. Some scattered chromatophores are present over the snout, dorsal aspect of the head and the upper portion of the trunk, above the lateral line. A conspicuous dark band extends down from the nape over the operculum on either side. More chromatophores have appeared on the body near the base of the dorsal fin. Chromatophores near the base of the anal fin have concentrated into a slightly elongated distinct dark spot. The caudal spot is conspicuous and is somewhat oval-shaped though a little pointed anteriorly. The major portion of this spot lies below the lateral line along which two more dark spots have appeared, a larger one at the level of the anal fin and a smaller one at the level of commencement of the dorsal fin.

All the fins are transparent and devoid of pigment. Snout is rather prominent, with thick lower lip. Maxillary barbels are pale whitish in colour.



Text-fig. 1.—*Labeo* (*Morulius*) *angra* (Ham.); Characteristic pigmentation of juvenile specimens: (*a*) 20 mm. long and (*b*) 29.0 mm. long.

Stage II: 25.5 mm.

General body colour remains pale yellowish. More chromatophores have appeared on the dorsal portion of the head. The pigment near the base of the dorsal fin is less conspicuous than in the previous stage. The ventral spot near the base of the anal fin persists. The caudal spot extends anteriorly and merges with the elongated blotch at the level of the anal fin. The spot at the level of the dorsal fin has elongated.

Stage III: 29.0 mm. (Fig. 1*b*)

Body appears more yellowish in colour. The caudal spot now extends forwards as a continuous dark band, almost extending to the operculum. The vertical band at the nape and the blotch near the base of the anal fin persist. No chromatophores are found on the body below the lateral line. A number of chromatophores are scattered all over the dorsal half of the body and head. All the fins are transparent and no pigment has appeared on any of them. Snout is prominent, overhanging the mouth. Lower lip is thick.

Stage IV: 43.0 mm. to 50.0 mm. long.

General body colour is bright yellow, often tending to become yellowish-brown. Lateral pigment band is still conspicuous and extends up to the operculum. The nape band and the anal blotch also persist.

Stage V: 68.5 mm. long.

Dorsal half of the body has become brownish but the ventral half is still bright yellowish. The blotch near the base of anal fin has disappeared. The nape band is rather inconspicuous.

Stage VI: 95.0 mm. to 119 mm. long.

The conspicuous lateral band is formed of a pigmented row of scales, besides the first 9-10 scales of the row immediately below it. The central portion of scales along the two rows immediately below the lateral line are golden yellow in colour, and this is quite prominent near the head region. Yellow and dark pigments extend over 2-3 rows of scales below the lateral line adding a faint bluish iridescence. Hind portion of operculum is golden yellow. The dorsal, anal and caudal fins have the tips pink while the middle portions are dark.

Adult specimen, 173 mm. long.

The dark brown lateral band persists and is still conspicuous. The caudal spot is confluent with it. The upper half of the body is dark brown, while the lower half is dirty yellow in colour. Scales adjoining the lateral pigment band are tinged reddish or golden. Day gives the colour as brownish along the back, with a black or bluish stripe passing from the eyes to the base of the caudal fin where it ends in a black blotch.

NOTES ON GROWTH

Certain structural changes take place with growth, particularly in the length of head, diameter of eyes, position of fins and nature of lips. Though only one specimen of each size has been measured the following table gives an idea of the relative proportion of the head, eyes and snout in the juvenile specimens measuring up to 50 mm. in total length.

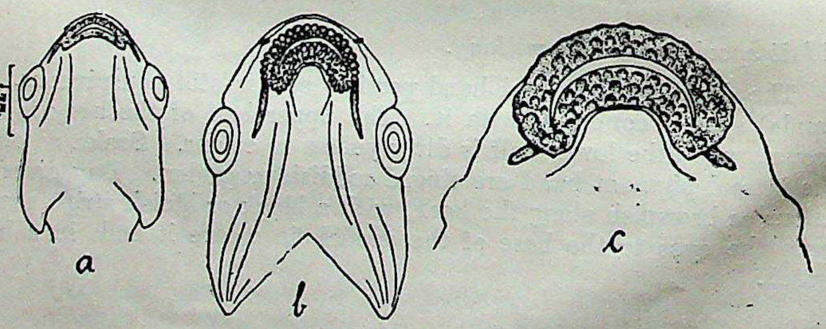
No.	Total length (mm.)	$\frac{\text{T.L.}}{\text{L.H.}}$	$\frac{\text{L.H.}}{\text{D.E.}}$	$\frac{\text{L.S.}}{\text{D.E.}}$	Remarks.
1.	12·8	4	4	1	...
2.	19·0	$3\frac{3}{4}$	$3\frac{3}{4}$	$1\frac{1}{4}$	...
3.	20·0	$3\frac{3}{4}$	$3\frac{3}{4}$	$1\frac{1}{4}$	...
4.	26·0	$3\frac{9}{10}$	$4\frac{1}{5}$	$1\frac{1}{3}$	...
5.	40·0	$4\frac{1}{4}$	$3\frac{5}{6}$	$1\frac{1}{6}$	...
6.	42·0	$4\frac{1}{4}$	$3\frac{5}{6}$	$1\frac{2}{6}$	...
7.	46·0	$4\frac{1}{4}$	$3\frac{6}{7}$	$1\frac{2}{5}$	...
8.	50·0	$4\frac{3}{10}$	$4\frac{1}{4}$	$1\frac{2}{5}$	..
9.	...	$5\frac{3}{4}$	$3\frac{1}{2}$–$4\frac{1}{4}$	$1\frac{1}{4}$–$1\frac{3}{4}$	Adult condition given by Day.

(T.L. = Total length ; L.H. = Length of head ; D.E. = Diameter of eye ; L.S. = Length of snout.)

Even in the 50 mm. stage the head is relatively much larger than in the adult, but the eyes and snout have attained adult proportions.

The dorsal fin also shows a forward migration, with growth. Up to the 20 mm. stage the commencement of the dorsal fin is distinctly nearer to the base of the caudal fin than to the tip of snout. In specimens 26 mm. to 29 mm. long, the origin of the dorsal is almost mid-way between the tip of snout and the base of caudal fin. From the 40 mm. stage onwards the origin of the dorsal fin has become much closer to the tip of snout than to the base of caudal fin. This represents the adult condition in *L. angra.*

Scales over the anterior part of the body have become distinct in the 20 mm. stage and about 8 scales along the lateral line are perforated. By the 29 mm. stage the scales are well formed and lateral line scales have all become perforated.



Text-fig. 2.—*Labeo (Morulius) angra* (Ham.): Ventral view of the head showing the structure of lips and barbels during growth. (*a*) Postlarva, 12.8 mm. long; (*b*) Juvenile specimen, 20 mm. long; (*c*) Same, 46 mm. long.

In the 12.8 mm. long post-larva the lips are thick but not fimbriated (Fig. 2*a*). The rostral barbels are very short while the maxillary pair is longer. The mouth, though ventral, is almost terminal in position; and is crescent-shaped. In the 20 mm. stage the lips have become conspicuously fimbriated, and the mouth is distinctly ventral in position and almost semi-circular in shape (Fig 2*b*). Both the rostral and maxillary barbels have become conspicuous. The lips are continuous and the fimbriations distinctly papillate. The upper lip has 2 distinct rows each of 18-19 papillae. In the lower lip the papillae near the margin are well developed, large and somewhat alternately arranged. Behind these there are 2-3 incomplete rows of smaller tubercles. In the 46 mm. stage the lips are still quite conspicuous but the tubercles are not so prominent as in the 20 mm. stage (Fig. 2*c*). Two irregular rows on the upper lip and 3 rows on the lower lip are perceptible, but unlike the papillate structure in the earlier stage, they appear only as short tubercles. The rostral barbels have disappeared; while the maxillary barbels have become very much shorter than in the 20 mm. stage. The adult condition, according to Day (1889, p. 267) is 'Mouth rather narrow, the lips continuous and with a deep groove across the chin; both the lips fimbriated'. Though in the adult specimen there is only a single pair of short, maxillary barbels (Day, p. 267), it is interesting to observe that a rostral pair of barbels had a transitory existence in the earlier stage of its life and that the maxillary barbels themselves were likewise longer and more conspicuous than in the adult. However, in his 'synopsis of Indian species' of the genus *Labeo* Day (p. 257) mentions *L. angra* as having 2 or 4 barbels.

As in other pond fishes growth depends mainly on the food and the density of fish population in the pond. 3-4 days old fry, stocked in nursery ponds along with similar fry of other carps have attained a maximum length of 29.0 mm. within 23 days. In another pond with larger population of carp fry the growth ranged from 20.0 mm. to 25.5 mm. only within 28 days. Approximately 49 days-old specimens measuring 46.0 mm. to 50.0 mm. in length, were transferred from the pond to a cement cistern where they attained a length of 96.0 mm. to 119.0 mm. within the next 76 days. The specimens were later released in a pond and when fished out 7 months after, had reached a maximum length of 173 mm. (weight 56.8 gms.). Adult size has been attained and this represents the growth during the first 11 months of its life. On dissection the gonads were found immature.

DISTINGUISHING CHARACTERS FROM *Labeo calbasu*

The characteristic yellowish ground colour of the body, the conspicuous dark lateral band and the absence of dark pigment on the fins, besides the non-pigmented barbels are important features by which the juvenile specimens of *L. angra* could easily be distinguished from *L. calbasu*. In the latter dark pigment is concentrated on the dorsal, ventral, anal and caudal fins, at their bases; while in the former species pigment appears as distinct spots on the body, near the dorsal, anal and caudal fins. The dark band at the nape is common for both the species, though in *L. calbasu*, this lies in between two distinct yellowish bands. Fingerlings of *L. angra* have the lateral pigment band very prominent, but in *L. calbasu* the body assumes a general dark brown colour. The barbels in *L. calbasu* are throughout conspicuous by their dark pigmentation.

SUMMARY

The characteristic pigment patterns of the post-larval and juvenile specimens of *L. angra* have been described. Certain structural changes that take place with growth, particularly the relative size of the head and eyes, the position of dorsal fin, and nature of lips and barbels have been detailed. Adult size is attained in the first year of life. Characters by which juvenile specimens and fingerlings could be distinguished from *L. calbasu* have been indicated.

ACKNOWLEDGEMENTS

We are indebted to Dr. S. L. Hora and Dr. S. Jones for kindly going through the manuscript and to Mr. E. G. Silas for drawing our attention to certain aspects of growth while verifying the identification of the species at the instance of Dr. Hora.

PLANTS FROM EAST NEPAL

BY

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PART II

[*Continued from p.* 423 *of Volume* 51 (2)]

PAPAVERACEAE

Annual or perennial herbs with milky or coloured juice, rarely watery. Leaves radical or alternate; stipules absent. Flowers often large and nodding, terminal, solitary, cymose or paniculate. Sepals 2-3, hypogynous, free or cohering in a cap, caducous. Petals 4 in 2 whorls, large, crumpled, rarely more or 0. Stamens indefinite in many series, rarely few; filaments slender, anthers basifixed, dehiscence lateral. Ovary 1-celled with 2 or many parietal placentas or these being prolonged, divided into many nearly complete cells. Style short or 0; stigmas radiating, as many as the placentas, free or adnate to and crowning the flat top of the ovary. Fruit 1-celled or by the intrusion of the parietal placentas a many-celled capsule, opening by 2 or 4 longitudinal valves or by pores at the top.

Key to the genera

Stigmas 4-6, radiating from the top of a depressed style ...	1. *Argemone.*
Stigmas 4-6, decurrent on the top of the style ...	2. *Meconopsis.*

1. ARGEMONE Linn.

An erect prickly annual. Flowers bright yellow; sepals 2-3; petals 4-6; stamens indefinite. Ovary 1 celled; style very short; stigma 4-7 lobed; ovules on 4-7 parietal placentas. Capsule short, opening at the top by valves; seeds many.

Argemone mexicana Linn.
Ref.: Burkill's Notes from a Journ. to Nepal.

2. MECONOPSIS Viguier.

Perennial herbs. Leaves entire or lobed. Flowers solitary or racemed, blue, yellow or purple. Sepals 2; petals 4. Ovary 1-celled; style distinct; stigmatic lobes radiating; capsule ovoid or elongated with short valves below the persistent style. Seeds many.

Key to the species

- Scapes radical, 1-flowered
  - Softly hairy; leaves lanceolate, entire or few-toothed. Sepals hispid. Capsule 2 in. covered with hairs 1. *M. simplicifolia.*
  - Prickly; leaves lanceolate, subentire. Sepals bristly. Capsule ½-1 in., prickly ... 2. *M. horridula.*
- Stems leafy. Flowers racemed or panicled
  - Glaucous or sparsely hairy. Leaves pinnate and lobes pinnatifid. Flowers 2-3 in. diam.; sepals bristly. Capsule 1½ in., densely bristly ... 3. *M. robusta.*
  - Pubescent and laxly hairy. Leaves sinuate-lobed or pinnatifid. Flowers 2-3½ in. diam.; sepals setose. Capsule 1½-2 in., clothed with appressed hairs ... 4. *M. nipalensis.*
  - Pubescent and softly hairy. Leaves oblong or obovate-lanceolate. Flowers 1½-2 in. diam.; sepals densely pubescent. Capsule 1 in., densely bristly ... 5. *M. wallichii.*

1. *Meconopsis simplicifolia* Hf. & T.

Ref.: Hooker's Flora British India 1: 118. *Wallich*, from Nepal.

2. *Meconopsis horridula* Hf. & T.

Banerji 360, Nangpa La pass!

3. *Meconopsis robusta* Hf. & T.

Ref.: Hooker's Flora British India 1: 118. *Wallich*, from Nepal.

4. *Meconopsis nipalensis* DC.

Ref.: Hooker's Flora British India 1: 118. *Wallich*, from Nepal. *Banerji* 276, Phaplu to Rhingmo! (In Herb. Calcut. Wall. sheet 8121).

5. *Meconopsis wallichii* Hk.f.

Ref.: Hooker's Flora British India 1: 119. *Wallich*, from Nepal.

FUMARIACEAE

Annual or perennial often glaucous herbs with watery juice. Leaves usually decompound. Flowers irregular, hermaphrodite in racemes. Sepals 2, small; petaloid or scarious, deciduous. Petals

4 in 2 very dissimilar pairs; 2 outer, one or both outer spurred or gibbous at the base; inner smaller, often cohering at the tip. Stamens 6, usually in two bundles opposite the outer petals; central anther in each bundle 2-celled, others 1-celled. Ovary 1-celled; style long or short; stigma obtuse or lobed. Ovules parietal. Fruit a 1-seeded nut or a bivalved, many-seeded capsule.

Key to the genera

Fruit a many-seeded capsule
  Both the outer petals with saccate bases or spurred ... 1. *Dactylicapnos.*
  Only one outer petal spurred (posterior.) ... 2. *Corydalis.*
Fruit a one seeded nut; only one outer petal spurred .. 3. *Fumaria.*

1. DACTYLICAPNOS

Glabrous, perennial rooting, climbing, slender herbs. Leaves decompound, petiole ending in a branched tendril. Flowers in leaf-opposed pendulous racemes or corymbs. Sepals 2, small; petals 4, connivent, 2 outer oblong, concave with saccate bases or spurred, 2 inner clawed, tips cohering. Stamens 6, diadelphous. Ovary 1-celled; style filiform; stigma bilobed. Ovules on parietal placentas. Fruit a capsule dehiscing by 2 longitudinal valves, leaving the seeds on a replum.

Key to the species

Capsules membranous, lanceolate; seeds smooth, shining ... 1. *D. scandens.*
Capsules fleshy, ovate-cordate; seeds granulate ... 2. *D. thalictrifolia.*

1. *Dactylicapnos scandens* (D.Don) Hutch.

Maries, no number, no locality! *Banerji* 521, Hatia to Hangaon!

2. *Dactylicapnos thalictrifolia* Wall.

Ref.: Hooker's Flora British India 1: 121. *Wallich*, from Nepal.

2. CORYDALIS DC.

Erect or prostrate herbs, usually perennial rooted. Leaves lobed or cut. Upper leaves sometimes opposite. Flowers in racemes, rarely sub-umbellate, small, white, blue, yellow or purple. Sepals 2, small; petals 4, erect or conniving; 2 outer dissimilar, anterior flat or concave; posterior gibbous or spurred at the base; 2 inner clawed, tip free or cohering, keeled. Stamens 6, diadelphous, posterior bundle with a basal spur enclosed in the petal-spur, mid-anther of each bundle 2-celled, lateral 1-celled. Ovary 1-celled; style filiform; stigmas 2, minute or dilated. Ovules on 2 parietal placentas. Capsules ovoid, oblong-elliptic or linear.

Key to the species

Erect, leafy, branched, fibrous-rooted herbs. Capsule narrow, linear. Racemes long-peduncled. Posticous petal concave, much shorter than the spur ...	1. *C. leptocarpa.*
Roots bulbous or rootstock elongated; stem simple. Radical leaves few or 0, cauline leaves opposite, alternate or whorled. Racemes undivided.	
Racemes erect. Outer petals equalling or shorter than the inflated obtuse spur ...	2. *C. rutaefolia.*
Racemes terminal. Posticous petals longer than the short obtuse spur	3. *C. juncea.*
Root fusiform. Stem or scape simple, rarely divided, leafless or with 1 or 2 leaves; leaves chiefly radical. Racemes undivided. Spurs equalling or exceeding the petals. Posticous petal very convex, shorter than the curved spur	4. *C. govaniana.*
Root fusiform. Stem branched. Racemes often divided. Spurs equalling or exceeding the petals. Posticous petal hooded, equalling or exceeding the conic spur ...	5. *C. sibirica.*

1. *Corydalis leptocarpa* Hf. & T.
Banerji 447, on way to Dingla!

2. *Corydalis rutaefolia* Sibth.
Ref.: Hooker's Flora British India 1: ? and Wallich's Tent. Fl. Nep. 54 (*C. diaphylla.*).

3. *Corydalis juncea* Wall.
Ref.: Hooker's Flora British India 1: 123. *Wallich*, from Nepal; and Wallich's Tent. Fl. Nep. 54.

4. *Corydalis govaniana* Wall.
Ref.: Hooker's Flora British India 1: ? and Wallich's Tent. Fl. Nep. 55.

5. *Corydalis sibirica* Pers.
Wallich 1433!

3. FUMARIA Linn.

Annual branched sarmentose herbs. Leaves finely divided. Flowers small, white or pink, with purple tips of the petals, in terminal or leaf-opposed racemes. Outer anterior petal flat, posterior gibbous at the base. Stamens diadelphous, posterior bundle with a spur at the base. Ovary 1-celled; style filiform; ovules 2 on 2 parietal placentas. Fruit indehiscent, 1-seeded nut.

Fumaria parviflora Lamk.

Wallich 1436A! Ref.: Burkill's Notes from Journ. to Nepal.

CRUCIFERAE

Herbs, rarely undershrubs, with watery juice, sometimes pungent. Leaves radical and cauline. Radical leaves in a rosette; cauline leaves alternate, exstipulate. Flowers racemed, rarely solitary, terminal or axillary. Sepals 4, 2 often large and saccate at the base, imbricate. Petals 4, hypogynous, imbricate. Stamens 6, rarely fewer or many, 4 inner and longer in opposite pairs. Disk with 4 glands opposite the sepals. Ovary 2-celled due to a replum, or 1-celled, or with many superposed cells; style short or 0; stigma entire or bilobed. Ovules usually many on 2 parietal placentas or rarely 1 or 2, erect. Fruit a siliqua or a silicula.

Key to the genera

Pods usually long, dehiscent, terete 4 angled or compressed dorsally	
Sepals erect not saccate. Pods flat; seeds 1-seriate. Flowers white or purple ...	2. *Cardamine*.
Sepals spreading not saccate. Pods cylindric; seeds 2-seriate. Flowers usually yellow ...	1. *Nasturtium*.
Glabrous herbs. Sepals short and erect. Seeds 1-seriate. Flowers white ...	3. *Eutrema*.
Hoary herbs with appressed hairs. Sepals erect. Seeds 1-seriate. Flowers white ...	4. *Erysimum*.
Sepals erect or spreading, laterally usually saccate. Stigma capitate, truncate or 2-lobed. Pods long	5. *Brassica*.
Pod short, dehiscent, compressed laterally, triangular, many-seeded ...	6. *Capsella*.

1. NASTURTIUM Br.

Terrestrial or aquatic herbs, glabrous or pubescent, branched. Leaves entire, lobed or pinnatifid. Flowers small, racemose, sometimes bracteate. Sepals spreading, not produced into a pouch at the base. Petals cuneate, hardly clawed, yellow or rarely white or 0. Stamens 2, 4, or 6. Pods long or short, nearly cylindric; valves 1-nerved.

Nasturtium palustre DC.
Ref.: Hooker's Flora British India 1: 133.

2. CARDAMINE Linn.

Annual or perennial herbs, glabrous or slightly pubescent. Leaves entire, lobed or pinnate. Flowers white, pale purple or violet or rarely yellow. Sepals not saccate; petals clawed. Pods narrow-linear, compressed tapering at both the ends; valves elastic, midrib distinct.

Key to the species

Leaves not deeply lobed or pinnatisect.
  Leaves sessile, amplexicaul, lanceolate, toothed. Flowers large, violet 1. *C. violacea.*
Radical leaves trifoliate. Leaves petiolate, leaflets 3-lobed. Flowers pale-lilac ... 2. *C. trifoliolata.*
Radical leaves, or all, pinnatisect
  Stem sub-erect or decumbent. Leaflets petioled, orbicular-ovate. Flowers small, white ... 3. *C. hirsuta.*
  Stem stout and erect. Leaflets ovate or lanceolate. Flowers large, white or deep violet ... 4. *C. macrophylla.*

1. *Cardamine violacea* Wall.
Ref.: Hooker's Flora British India 1: 137. *Wallich*, from Nepal.

2. *Cardamine trifoliolata* Hf. & T.
Banerji 526, Hongaon to Popti La Pass!

3. *Cardamine hirsuta* Linn.
Ref.: Burkill's Notes from a Journ. to Nepal; *Mukerji.*

4. *Cardamine macrophylla* Willd.
Ref.: Hooker's Flora British India 1: 139.

3. EUTREMA Br.

Biennial or perennial herbs, glabrous. Leaves entire or serrate, radical on long petioles, upper short petioled or sessile. Flowers white, corymbose; sepals short, erect, equal at the base. Pods linear or linear-oblong, terete; seeds few, irregularly 1-2 seriate.

Eutrema primulaefolium Hf. & T.
Scully, no number, no locality!

4. Erysimum Linn.

Herbs with appressed hairs. Leaves linear or oblong, entire or sinuate-toothed, base not auricled. Flowers yellow rarely purple, ebracteate. Sepals erect, equal or lateral gibbous at the base; petals clawed. Pods elongate, narrow, compressed tetragonally or terete; seeds numerous, 1-seriate.

Key to the species

Leaves oblong, sinuate-toothed, upper sessile. Pedicels equalling the sepals, stout, upcurved; style slender	1. *E. hieraciifolium.*
Leaves petioled, lanceolate, sinuate-toothed. Pedicels much shorter than the sepals; style thick ...	2. *E. pachycarpum.*

1. *Erysimum hieraciifolium* Linn.
Ref.: Hooker's Flora British India 1: 153. *Wallich,* from Nepal.

2. *Erysimum pachycarpum* Hf. & T.
Banerji 262, Phaplu to Rhingmo!

5. Brassica Linn.

Glabrous or hispid herbs; rootstock often woody. Leaves large, pinnatifid or lyrate, rarely entire. Flowers yellow in large racemes. Sepals erect or spreading, lateral usually saccate at the base. Pods elongate, terete or angular; seeds 1-seriate, globose.

Brassica trilocularis Hf. & T.
Ref.: Hooker's Flora British India 1 : 156.

6. Capsella Moench.

Small branched herbs, radical leaves in a rosette, entire or pinnatifid. Sepals spreading, not gibbous at the base. Pods obcordate, ovate-oblong, cuneate, laterally compressed; valves boat-shaped; seeds many, 2-seriate.

Capsella bursa-pastoris Moench.
Scully 98, no locality!

CAPPARIDACEAE

Herbs or shrubs, erect or climbing, rarely trees. Leaves alternate, or very rarely opposite, simple or palmately 3-9-foliate; leaflets usually entire; stipules spinescent or minute or 0. Flowers solitary, racemed, corymbose or umbellate; regular or rarely a little irregular; bisexual or rarely dioecious. Sepals generally 4, free or connate, usually imbricate; petals 4, rarely 0 or very rarely 2, imbricate, hypogynous, or sometimes inserted on the disc. Stamens usually 6, sometimes 4 or numerous, hypogynous or perigynous or inserted at the base of or on a long or short gynophore. Ovary usually stalked, 1-celled; stigmas usually capitate, sessile; ovules many on 2-4 parietal placentas. Fruit a pod-like capsule or a berry or rarely a drupe.

Key to the genera

Herbs with usually digitate leaves and capsular fruit. Ovary long-stalked; stamens 6, inserted on the gynophore; leaves 3-foliate	1. *Gynandropsis.*
Trees or shrubs with usually simple leaves; fruit usually a berry. Thorny or unarmed ...	2. *Capparis.*

1. GYNANDROPSIS DC.

Annual leafy herbs. Leaves long petioled, digitately 3-7-foliate. Flowers bracteate, white or purple in racemes. Petals 4, spreading, long clawed. Stamens about 6, inserted upon a long gynophore, spreading. Ovary stalked, 1-celled; ovules many on 2 parietal placentas. Capsule oblong or linear.

Gynandropsis pentaphylla DC.
Wallich 6868 !

2. CAPPARIS Linn.

Trees or shrubs, erect or straggling or climbing, unarmed or with stipular thorns. Leaves simple or 0. Flowers white or coloured, often showy. Sepals 4, free in 2 whorls, all imbricate or outer valvate. Petals 4, imbricate, 2 rarely united into a short spur at the base. Stamens long, numerous, inserted on the torus at the base of the gynophore. Ovary stalked, 1-4-celled; ovules many on 2-6 parietal placentas. Fruit fleshy rarely dehiscing by valves.

Key to the species

A large woody climber, thorns 0; leaves large. Flowers small ...	1. *C. multiflora.*
An erect shrub, thorns straight or slightly curved. Flowers large, white; anthers blue ...	2. *C. olacifolia.*

1. *Capparis multiflora* Hf. & T.

Ref.: Hooker's Flora British India 1 : 178. *Hooker*, from E. Nepal?

2. *Capparis olacifolia* Hf. & T.
Banerji 104, Tinpipli to Nepalthoke !

V. 51/3
590.5
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VIOLACEAE

Herbs, (shrubs or trees). Leaves alternate or very rarely opposite, entire, crenate, serrate or pinnatisect, stipulate. Flowers regular or irregular; sepals 5, equal or unequal, imbricate or contorted in bud. Stamens 5, free or monadelphous; anthers erect, connectives produced beyond the cells. Ovary sessile, 1-celled; style simple; stigma terminal or lateral, capitate, truncate or capsular, entire or lobed. Ovules many on 3 parietal placentas. Fruit a 3-valved capsule, rarely a berry.

VIOLA Linn.

Herbs rarely woody below. Flowers 1-2 on long axillary peduncles, often dimorphic, sometimes large-petalled but ripening few seeds, sometimes small-petalled ripening many seeds. Sepals produced at the base; petals erect or spreading, lower largest spurred at the base. Anthers connate, connectives of the lower 2 often produced into spur within the corolla spur. Style clavate or truncate, tip straight or bent.

Key to the species

Stigma oblique, 2-lobed, not beaked; lobes short and spreading. Leaves reniform; flowers yellow ... 1. *V. biflora.*
Stigma terminal, truncate, dilated, depressed, orbicular or lobed :
  Stipules free
    Stemless but with stolons. Leaves elliptic ovate obtuse, crenate... 3. *V. diffusa.*
    Stem and stolon short. Leaves orbicular-reniform, broadly crenate; stipules toothed or lacerate ... 4. *V. hookerii.*
    Stem and stolon long. Leaves ovate-cordate or deltoid-cordate; stipules fimbriate. Stigma indistinctly 3-lobed ... 5. *V. distans.*
  Stipules adnate. Plants stemless. Leaves triangular-lanceolate, not deeply cordate; petioles winged. Stigma distinctly 3-lobed ... 2. *V. patrinii.*
Stigma oblique or lateral, often minute and perforated. Long leafy stem and stolons. Stipules free. Sepals linear, gradually attenuated from a lanceolate base. ... 6. *V. serpens.*

1. *Viola biflora* Linn.

Banerji 437, beyond Paktaru!

2. *Viola patrinii* DC.
   Wallich 1445!

3. *Viola diffusa* Ging.
   Ref.: Hooker's Flora British India 1: 183. (Nepal).

4. *Viola hookerii* T. Thoms.
   Banerji 387, Puyia to Jubing!

5. *Viola distans* Wall.
   Maries, no number, no locality!

6. *Viola serpens* Wall.
   Scully 59, no locality! *Banerji* 388, Puiya to Jûbing!

   var. *canescens* Wall. Often stemless, hoary or pubescent.
   Banerji, no number, Chandragiri range!

FLACOURTIACEAE

Trees or shrubs. Leaves simple, alternate, usually distichous. Stipules usually small and caducous. Flowers small, axillary, or in lateral or terminal cymes or racemes with small bracts, regular, bi-sexual, monecious or dioecious. Sepals 4-several, free, sometimes not distinguishable from the petals, imbricate or open in bud. Petals present or 0, sometimes not arranged regularly in relation to the sepals; with or without an opposite scale inside the base, imbricate. Stamens indefinite, rarely few, hypogynous, free; anthers 2-celled, often short, opening lengthwise. Ovary 1-celled, with usually 3-5 parietal placentas, which sometimes meet in the axis making the ovary many celled. Styles and stigmas as many as the placentas. Fruit indehiscent, mostly a berry or drupe, very rarely a capsule.

Key to the genera

Petals 4-6 ...	1. *Scolopia.*
Petals absent	
Ovary incompletely 2-6 celled; styles as many ...	2. *Flacourtia.*
Ovary 1 celled; style usually connate ...	3. *Xylosma.*

1. SCOLOPIA Schreber

Trees, spinous, spines often compound. Leaves alternate, entire, stipules minute or 0. Flowers small, racemed, axillary, 2-sexual. Sepals and petals 4-6 each, imbricate in bud. Stamens many, anthers ovoid, connectives produced above. Ovary 1-celled; style erect; stigma entire or lobed; ovules few on 3-4 parietal placentas. Fruit a berry, 2-4-seeded.

Scolopia crenata Closs.
   Banerji 123, Nepalthoke to Mulkote!

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2. Flacourtia Commers.

Trees or shrubs, usually thorny. Leaves toothed or crenate. Flowers small, usually dioecious. Sepals small, imbricate. Petals 0. Stamens many, anthers versatile. Ovary on a glandular disc, imperfectly or rarely perfectly 2-8-celled, usually with 2-8 deeply intruded placentas. Styles and stigmas several, and stigmas notched. Fruit a berry.

Flacourtia ramontchi L'Herit.

Ref.: Burkill's Notes from a Journ. to Nepal.

3. Xylosma Foster

Characters of *Flacourtia*. The ovary in many cases imperfectly 2-3-celled; stigmas are sometimes 2-3, and these are split nearly to the base. (Scarcely separable from *Flacourtia*.)

Key to the species

Male flowers in racemes. Leaves 4-9 in. ... 1. *X. longifolium.*
Male flowers in panicles. Leaves 3-6 in. ... 2. *X. controversum.*

1. *Xylosma longifolium* Closs.

Burkill 29913, Sangu to Trisuli.

2. *Xylosma controversum* Closs.

Ref.: Hooker's Flora British India 1 : 199. *Wallich*, from Nepal.

PITTOSPORACEAE

Trees, erect or climbing shrubs or undershrubs. Leaves alternate fascicled, very rarely opposite or verticillate, entire or very rarely toothed. Flowers hermaphrodite, in various terminal or axillary inflorescences. Sepals 5, free or connate, imbricate. Petals 5, hypogynous, free or connate, imbricate. Torus small. Stamens 5, free anthers versatile. Ovary 1-celled with 2-5 parietal placentas, or as many celled by the projection of placentas; style simple; stigma terminal, 2-5-lobed; ovules many. Fruit capsular or indehiscent.

Pittosporum Banks.

Erect trees, (*shrubs or undershrubs*). Inflorescence usually corymbose, subumbellate or paniculate. Sepals 5, free or connate below. Petals erect, recurved at the top, claws connivent or connate. Stamens erect, 5; anthers bursting inwards. Ovary sessile or shortly stalked, incompletely 2-3-celled; ovules 2 or more on each placenta. Fruit a capsule.

Pittosporum nepalense (DC.) Rhd. & Wils.

Wallich 8127D ! *Banerji* 2, Pashupatinath temple area !

POLYGALACEAE

Annual or perennial herbs, erect or climbing shrubs, (or large trees). Leaves usually simple, exstipulate, entire or occasionally reduced to scales. Flowers hermaphrodite, irregular, bracteate, axillary, spicate or racemed. Sepals 5, free, imbricate, 2 inner (wings) often petaloid and larger. Petals 5 or 3, the anterior (Keel) usually different and carinate. Stamens 4-5 or usually 8, hypogynous, monadelphous, rarely distinct. Ovary free, 1-3-celled; style simple, generally curved, filiform or variously dialated; stigma capitate. Ovules 1 or more in each loculus. Fruit generally a 2-celled, 2-seeded loculicidal capsule.

Key to the genera

Annual herbs. Flowers minute in long terminal spikes; sepals nearly equal; stamens 4-5 ... 1. *Salomonia.*

Herbs or shrubs. Flowers fairly large; 2 sepals larger (wing sepals); stamens 8 ... 2. *Polygala.*

1. SALOMONIA Lour.

Small branched or unbranched annuals. Flowers minute in dense terminal spikes. Sepals nearly equal. Petals 3, united at the base with the staminal tube, the inferior one keel-shaped, hooded, not crested. Stamens 4-5; filaments united into a sheath below. Ovary 2-celled, 1 ovule in each loculus. Fruit a loculicidal capsule, laterally compressed, 2-celled.

Key to the species

Lateral petals much shorter than the keel; sepals lanceolate ... 1. *S. oblongifolia.*

Lateral petals broad and nearly as long as the keel; sepals ovate ... 2. *S. edentula.*

1. *Salomonia oblongifolia* DC.

Ref.: Hooker's Flora British India 1: 207.

2. *Salomonia edentula* DC.

Ref.: Hooker's Flora British India 1: 207. *Wallich*, from Nepal.

2. POLYGALA Linn.

Herbs, rarely shrubs. Leaves alternate. Sepals usually persistent, 2 inner larger and sometimes petaloid. Petals 3, lower boat-shaped and usually crested at the tip. Stamens 8, monadelphous. Ovary 2-celled; 1 ovule in each cell. Fruit a 2-celled loculicidal capsule.

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Key to the species

Shrubs. Keel crested; flowers yellow in drooping terminal racemes; strophiole large ... 1. *P. arillata.*

Herbs. Keel not crested; flowers yellow in erect terminal racemes; strophiole with 2 minute appendages ... 2. *P. triphylla.*

Herbs. Keel crested
  Bracts persistent
    Undershrubs. Racemes axillary, usually shorter than the leaves; strophiole with 2 appendages ... 3. *P. crotalarioides.*
    Herbs. Strophiole without appendage
      Racemes dense flowered; bracts 2 as long as the buds; flowers blue; wings narrow ... 4. *P. leptalea.*
      Racemes lax flowered; bracts small; flowers rose-coloured; wings broad ... 5. *P. persicariaefolia.*
  Bracts caducous. Flowers blue in extra-axillary racemes. Capsules broadly winged; strophiole with 3 appendages ... 6. *P. sibirica.*

1. *Polygala arillata* Buch.-Ham.

Wallich (?)! *Scully* 144, no locality! *Burkill* 29943, Thansing to Sangli khola.

2. *Polygala triphylla* Buch.-Ham. var. *glaucescens* Wall. Leaves 1-2 in., elliptic; flowers yellow.

Wallich 4182!

3. *Polygala crotalarioides* Buch.-Ham.

Wallich 4176! *Scully* 27 and 46, both with no locality!

4. *Polygala leptalea* DC.

Ref.: Hooker's Flora British India 1: 202, Nepal; *Burkill* 29526, Kuro nadi near Hettaunda.

5. *Polygala persicariaefolia* DC.

Wallich 4185!

6. *Polygala sibirica* Linn.

Wallich 4186! *Banerji*, no number, no locality!

CARYOPHYLLACEAE

Herbs, sometimes a little woody at the base, branches jointed, and thickened at the joints. Leaves opposite, usually quite entire; stipules scarious, setaceous or even 0. Flowers rarely unisexual. Sepals 4-5, free, imbricate in the bud or united into a toothed calyx.

Petals 4-5, entire, toothed or bifid, sessile or clawed or sometimes 0. Stamens 8-10, rarely fewer, inserted with the petals and sometimes slightly adherent to them. Disc annular or glandular or elongated into a gynophore. Ovary free, 1-celled or imperfectly 3-5-celled; style 2-5, free or connate; ovules 2 or many on a free central or on a basal placenta. Fruit a dry capsule, dehiscing by teeth or valves or irregularly, rarely indehiscent.

Key to the genera

Calyx gamosepalous. Styles 5, free; Capsule 1-celled. Stipules 0 ...	1. *Lychnis*.
Calyx of free sepals	
Stipules 0; style free	
Petals notched or entire. Capsule cylindric or conic. Styles 3-5	2. *Cerastium*.
Petals 2-fid. Capsule globose, ovoid or oblong. Styles 3-5 ...	3. *Stellaria*.
Petals entire. Capsule depressed. Styles 2 ...	4. *Brachystemma*.
Petals entire or lacerate. Capsule globose, ovoid or oblong. Styles 2-3 ...	5. *Arenaria*.
Petals entire, minute or 0. Capsule 4-5-valved. Styles 4-5	6. *Sagina*.
Stipules scarious. Styles 2-3, united.	
Sepals not keeled. Petals 2-6 fid	7. *Drymaria*.
Sepals keeled. Petals entire ...	8. *Polycarpon*.

1. LYCHNIS Linn.

Annual or perennial herbs. Flowers solitary or cymose. Calyx more or less inflated, ovoid campanulate, clavate or tubular, 5-toothed or cleft. Petals 5, claws narrow, limb entire or bifid. Stamens 10; disc usually produced into a long gynophore. Ovary 1-celled; styles usually 5.

Key to the species

Stem elongate; leaves linear-lanceolate; flowers very few on elongate racemes	1. *L. multicaulis*.
Stem diffusely dichotomous; leaves elliptic or ovate-lanceolate; panicle lax, many-flowered ...	2. *L. indica*.

1. *Lychnis multicaulis* Wall.

Ref.: Hooker's Flora British India 1: 224. *Wallich*, from Nepal.

2. *Lychnis indica* Benth. var. *indica* petals with a short bifid blade, lobes entire or 2-toothed; styles 2.

Wallich 624!

2. CERASTIUM Linn.

Pubescent herbs. Leaves usually small. Flowers in terminal dichotomous cymes, white. Sepals 5, rarely 4. Petals as many, notched or bifid, rarely entire, sometimes 0. Stamens 10, rarely few. Ovary 1-celled; styles usually 3-5; ovules many. Capsule cylindric, often curved near the top, dehiscing by teeth.

Key to the species

Leaves small, ovate, obtuse; sepals acute ...	1. *C. glomeratum.*
Leaves usually lanceolate or obovate-lanceolate, acute; sepals lanceolate...	2. *C. triviale.*

1. *Cerastium glomeratum* Thuill.

Ref.: Burkill's Notes from a Journ. to Nepal; *Wigram* 146, no locality! *Banerji* 50, Bhadgaon to Dhulikhel.

2. *Cerastium triviale* Link.

Ref.: Burkill's Notes from a Journ. to Nepal.

3. STELLARIA Linn.

Herbs of various habits. Leaves various. Flowers in dichotomous cymes or rarely solitary and terminal, white. Petals 5 or rarely 4, 2-fid or 2-partite or 0. Stamens 10, rarely 8. Disc annular or glandular. Ovary 1- or rarely 3-celled; styles 3, rarely 2-5; ovules many. Capsule short, splitting to below the middle into entire or bifid valves.

Key to the species

Ovary 3-celled. Stem with a line of hairs, nodes often hairy; leaves sessile, oblong or linear-oblong. Sepals equal to or half of the petals	1. *S. crispata.*
Ovary 1-celled. Stem with a line of hairs; leaves obovate or elliptic-lanceolate. Sepals 4-5, much shorter than the broad petals ...	2. *S. bulbosa.*
Ovary 1-celled. Sepals more or less connate at the base. Filaments not suddenly dilated at the base	
Stem cylindric, with stellate tomentum. Sepals tomentose exceeding the 2-partite petals ...	3. *S. saxatilis.*
Stem 4-angled, glabrous or with few hairs at the base of the leaves. Petals minute or 0 ...	4. *S. uliginosa.*
Ovary 1-celled. Sepals connate at the broad base. Filaments dilated at the base ...	5. *S. decumbens.*

1. *Stellaria crispata* Wall.
   Ref.: Hooker's Flora British India 1 : 229.

2. *Stellaria bulbosa* Wall.
   Banerji 320, Puyia to Ghate!

3. *Stellaria saxatilis* Wall.
   Ref.: Hooker's Flora British India 1 : 232. *Wallich*, from Nepal; *Burkill* 29674, Markhu.

4. *Stellaria uliginosa* Linn.
   King's Collector, no number, no locality (in Herb. Calcut.)! As far as I can find, King did not send any collector to Nepal. If he did send one, then it must have been along the Nepal-Sikkim boundary.

5. *Stellaria decumbens* Edgw. var. *pulvinata* Hk.f. forming dense globose or cushion-like masses; leaves densely imbricate, ovate-subulate. Flowers solitary; sepals 4-5, coriaceous.
   Mukerji.

4. BRACHYSTEMMA Don.

A diffuse sub-scandent branching herb. Leaves lanceolate. Flowers in axillary or terminal panicles. Sepals 5, sub-scarious. Petals 5, minute, narrow and entire. Stamens 10, 5 without anthers. Ovary 1-celled; styles 2; ovules 4. Fruit a capsule, depressed, globose and 4-valved.

Brachystemma calycinum Don.

Wallich (in Herb. Calcut. with no number, but bearing Wallich's handwriting)! Burkill 28161, Supari-Tar, & 28168, Nimbua Tar; *Banerji* 308, Rhingmo to Jubing!

5. ARENARIA Linn.

Annual or perennial herbs, often tufted. Leaves broad or narrow. Flowers white or pink, solitary or in dichotomous cymes. Sepals 5. Petals 5, entire, lacerate or retuse, never bi -fid or -partite, rarely 0. Stamens 10, rarely 5. Ovary 1-celled; styles 3-4, rarely 2; ovules many. Fruit a capsule, short rarely exceeding the sepals.

Key to the species

Flowers always solitary, sessile or very shortly pedicelled
  Plants forming compact hemispherical tufts. Leaves spreading. Petals retuse ... 1. *A. globifera*.
  Plants forming large compact tuft. Leaves recurved. Petals linear-lanceolate, acute ... 2. *A. densissima*.

Cymes few- or many-flowered, rarely 1-flowered. Plants branching from the roots. Sepals exceeding the petals 3. *A. serpyllifolia.*

1. *Arenaria globifera* Wall.

Ref.: Hooker's Flora British India 1: 238. *Wallich*, from Nepal. *Scully* 219, no locality!

2. *Arenaria densissima* Wall.

Ref.: Hooker's Flora British India 1: 239. *Wallich*, from Nepal. *Banerji* 361, Nangpa La!

3. *Arenaria serpyllifolia* Linn.

Burkill 29684, Chitlong.

6. SAGINA Linn.

Small herbs. Leaves linear-subulate, connate at the base, exstipulate. Flowers small, globose, solitary, axillary or terminal. Sepals 4-5. Petals 4-5, entire or 0. Stamens 4-10. Ovary 1-celled; styles 4-5; ovules many. Fruit a capsule, 4-5 valved.

Sagina procumbens Linn.

Banerji 250, Patale to Phaplu!

7. DRYMARIA Willd.

Diffuse glabrous herbs. Leaves rounded; stipules of several bristles. Flowers in axillary and terminal cymes. Sepals 5; petals 5, bi- to 6-fid. Stamens 3-5. Ovary 1-celled; style 3-fid; ovules 3 or many. Fruit a 3-valved capsule.

Drymaria cordata Willd.

Wallich 647! *Burkill* 29548, Hettaunda.

8. POLYCARPON Linn.

Diffuse or erect and dichotomously branched herbs. Leaves opposite, or from the presence of axillary fascicles appearing whorled; stipules scarious. Flowers crowded with many scarious bracts. Sepals 5, keeled. Petals 5, small, hyaline, entire or notched. Stamens 3-5. Ovary 1-celled; style short, 3-fid. Fruit a 3-valved capsule.

Polycarpon loeflingiae Benth. & Hook.f.

Ref.: Burkill's Notes from a Journ. to Nepal.

TAMARICACEAE

Mostly bushes or small trees. Leaves minute, scale-like, rarely sheathing, sometimes fleshy; stipules 0. Flowers usually spicate or in crowded racemes, small, regular. Sepals and petals 5 each, rarely 4, sometimes a little connate below. Stamens 5-10 or many, free or connate below. Ovary free, 1-celled or imperfectly 2-5-celled; styles 2-5, free or connate; ovules 2-many on basal placentas. Fruit a 3-valved capsule.

MYRICARIA Desv.

Fastigate shrubs. Leaves small, narrow, sessile, often crowded. Inflorescence of lateral or terminal spike-like racemes. Flowers rose-pink. Stamens 10, alternately long and short, monadelphous. Ovary tapering with 3 sessile stigmas; placentas basal; ovules many.

Myricaria germanica Desv.
Mukerji; *Banerji* 373, Namchebazar to Dingbochee!

(*To be continued*)

WILD LIFE PRESERVATION IN INDIA[1]

BY

LIEUT.-COL. R. W. BURTON, I.A. (Retd.)

During the past sixty-five years there have appeared in our journal no less than eighty references of one kind and another on the subject of protection of wild birds and animals, the abolition of the plumage trade, the conservation of game birds and animals, the preservation of game and wild life. There have been the Society's proceedings, reports by the honorary secretaries, editorials and contributed articles. Generally, through the pages of the *Journal* the Society has greatly contributed to bring about such legislation as has been enacted during this long period.

Prominent among the protagonists for the protection and conservation of wild life have been the late Theodore Hubback whose forceful and beautifully illustrated articles have done, and are still doing, so much for the cause we all have at heart; Mr. S. H. Prater, the Society's curator, who twenty years ago designed and conducted the notable series, 'The Wild Animals of the Indian Empire and the problem of their Preservation'; the Conservators of Forests and other experts who contributed to that series; Sir Reginald Spence who, during his term of office as honorary secretary and editor did so much for wild life (and fisheries); Mr. Sálim Ali who has done so much particularly in the matter of nature study; and Lieut.-Col. R. W. Burton who wrote the pamphlet of 1948 and the supplement to it which were widely distributed by the Society as related in the Honorary Secretary's Report in Vol. 47, p. 792 (1949), and who contributed from time to time other papers on the subject.

1952 AND A CENTRAL BOARD FOR WILD LIFE

After an interval of years there arrived in 1952 a revival of activity on the part of the Government of India, and the Ministry of Food and Agriculture Resolution of April 4th 1952 constituted and appointed a Central Board for Wild Life (now 'Indian Board for Wild Life') with its functions defined and terms of business arranged.

The first meeting of the Board assembled at Mysore from the November 25th to the 1st of December 1952 under the chairmanship of His Highness the Maharaja of Mysore, who observed in his Inaugural Address how fortunate it is that we have as Vice-Chairmen K. S. Dharmakumarsinhji of Bhavnagar and Shri M. D. Chaturvedi, the Inspector-General of Forests, and remarked upon the strength and inspiration afforded by the distinguished body of naturalists, conservationists and experienced officers of the various Forest Departments of the different States of India who are now serving on the Board. The inclusion of a number of officials and non-officials raised the twelve members appointed by the original Resolution to close upon forty at this first session. It is understood that the 23 recommendations of the Board have been accepted by the Government with the single exception that the matter of the declaration of the Indian Board for Wild Life as an institution of national importance is held over just now for reasons of legislative convenience.

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[1] Text of the farewell address delivered at a meeting of members of the Bombay Natural History Society on April 15, 1953.

THE CONFERENCE AT MYSORE

The proof of a conference being in its sequel, it is a good augury that some press notices from New Delhi indicate activity in several respects: for instance, formation of zoological parks near cities and large towns; and the calling for statistics from the States governments regarding their holdings of wild birds and wild animals in their respective areas. The recommendation that the Indian Lion needs another locality besides the Gir Forest is also receiving attention in a practical way.

One of the first results from the constitution of the Board of Control is the compilation at the instance of His Highness of Mysore, and with his financial assistance also, of a volume, 'The Preservation of Wild Life in India—A Compilation' (i-xiii + 176 pages and same size as our journal). The genesis of the book is contained in the first paragraph on p. 863 of the *Journal* for August 1952, and the 500 copies which have been printed are being now (April 8th) distributed to persons and institutions in India and abroad, perhaps also to the Press, in accordance with a list prepared by the Secretary of the Indian Board for Wild Life. It is possible that, should there be sufficient demand by others for priced copies, a second printing would be made. This would require the sanction of His Highness of Mysore. The price would probably be Rs. 4-8-0 ex postage and intimation of requirements would be received by the Secretary of the Board, who is also Under-Secretary to the Government of India in the Food and Agricultural Ministry, New Delhi.

The Foreword by Mr. Girja Shankar Bajpai, Governor of Bombay and President of the Bombay Natural History Society, observes that the book brings together in convenient compass the relevant literature on the subject.

'THE PRESERVATION OF WILD LIFE IN INDIA—A COMPILATION'

The introduction by the compiler, Lt.-Col. R. W. Burton, states the purpose of the book is to assist the cause of wild life through endeavour to place in readily accessible form before all the committees that will be formed in the States and Unions the principal contents of the various important articles which have been from time to time contributed to the *Journal of the Bombay Natural History Society*. There are also important editorials and other papers which greatly aid right knowledge and understanding of the many and varied aspects of this complex question. All these are dealt with in the Summarized Index of the compilation which consists of 102 paragraphs having references and cross references to the reprints contained within it. Appendix 'A' of the compilation gives a summary of the speeches delivered at the Mysore meeting, and Appendix 'B' prints the Resolutions Adopted by the Board at its First Session. The eighty references previously mentioned are listed at pages 116-119 of the compilation. Among the List of Contents is reference to 'The Book of Indian Animals' by S. H. Prater (Rs. 16 to non-members) a copy of which should be with all who have interest in the wild animals of India, and is essential to the secretaries of all wild life boards and committees.

While all the paragraphs of the Summarized Index are more or less important as concerned with the past and present situation of many of the wild birds and wild animals and the general question of their preservation, there are some which call for particular mention.

Some present day Problems

All of us know that *afforestation* is one of the most pressing needs of this sub-continent at the present time. In his address to the Indian Science Congress at Allahabad in 1949 Mr. M. S. Randhawa observed that nature conservation and conservation of soil, forests, grass-land and water are intimately connected, and just as fundamental to agriculture, horticulture, forestry, game preservation, fisheries, etc., as it is to the management of National Parks. Readers of the *Journal* will have in mind Mr. Randhawa's illuminating article on the progressive desiccation of northern India and the effect this has had, and is still having, on wild life in those parts; and will wholly agree with his urge that re-afforestation is the sovereign remedy to check soil erosion, and 'Plant More Trees' should be our slogan for the next many decades.

Just as afforestation favourably affects wild life so is disafforestation its deadly enemy. A sub-leader in *The Mail*, Madras, of October 16th 1952 clearly demonstrates how those same forces of destruction which brought about the desiccation of northern India and the Siwaliks are at this very time being practised by the government and the people of several named taluks in the Madras State; and it is well-known that this same process is at work in other parts of country also. In this connection it can be fittingly quoted, 'Many are the paths along which Man proceeds to destruction though his main object is his own survival.' Of the 19,000 square miles of forests in the Madras State there are 16,000 open to grazing.

Mr. A. A. Dunbar Brander has advocated as a remedial measure, 'Establishing associations for the protection of wild life, and rousing educated public opinion, and enlisting influential men as members of such societies.' The long established Nilgiri Game Association is a well-known example of what can be effected through good and continued organization. There are also successful associations of the kind in northern Bengal. The recently constituted Sportsmen's Club of Orissa (1949), should it have had continued success, and be taken as a model by other States and Unions, should result in largely aiding the functions of the Indian and other boards of control for wild life throughout India.

CONSERVATION, CONTROL, FOREST STAFF, GAME FUND, REAL INTEREST

Regarding conservation and control it is well expressed by the editorial of the May 1952 *Bulletin of the I.U.P.N.* that, 'More and more game will only be able to survive in so far as Man himself is both able and willing to set a limit to killing.' That is one of the important functions of the Boards and Committees—to set a limit to killing. Theodore Hubback declared, 'I think we may claim that the chief object of the conservation of wild life must be to prevent the disappearance of species'. Phythian-Adams correctly states, 'Wild life is a very real national asset and no one can object to all reasonable steps being taken for its preservation.' One of the main difficulties in preservation and protection of wild life is that of enforcement. One principal remedy is increase of forest staff, and this would be possible were a Game Fund established in all States and Unions, and at the Centre also. The case for the Game Fund is plainly and logically stated in paragraph 31 of the Summarized Index.

Real interest denotes considerably more than casual interest, and has been frequently urged as an essential to the preservation of wild life. It is bound up with public opinion and with nature study. 'In power politics a well informed public opinion is the world's greatest security. So also in regard to wild life, real and correctly informed interest on the part of the public is its greatest protection.' There is urgent need in India for creating and stimulating a real interest in the wild life of the country which also means the protection of the forests—and not only by the governments. Besides the governments the editors and journalists too have a duty in this matter. An essential to enable Boards of Control and Committees give effect to function 3 (iii)—'to promote public interest in wild life and the need for its preservation in harmony with natural and human environment'—is the widest publicity through government channels and the newspapers; and an imperative help is the whole-hearted aid by editors and journalists both in the papers and periodicals in English and in the regional languages also. No less a person than the Vice-President of the Republic of India has declared (16-9-52), 'It is the duty of the Press to produce the climate of opinion which would help the Government achieve its objectives.'

WHAT IS MEANT BY 'WILD LIFE?'

'Wild life' at the present juncture, means, in most of the literature, the game birds and the larger animals. Game is part of the natural heritage of the country which it is incumbent on the State and on the present generation to preserve for posterity. But unless active and continued, and continual, steps are taken what will be the result? Nothing but the gradual elimination of the game birds and the larger animals of the country. Once it is gone no efforts of mankind can restore it. In many parts of the country there are people of middle age who have seen the disappearance of species within the period of their lives. The beauty and interest of the creatures they have seen will not be known to their descendants. In his Foreword to this recent compilation our Society's President very rightly points out how lifeless and wanting in interest will be our forests when the game has gone.

The value of wild life is considerable; and this apart from certain considerations of science which could be mentioned. Prominent among the magnets for attracting tourists in India is the spectacle of wild life and its abundant interest for all classes of sportsmen and sightseers. Who can gainsay that?

ZOOLOGICAL AND OTHER PARKS

The formation of Zoological Parks in the vicinity of all the cities and larger towns in India is one of the suggestions in the 'Delhi Memorandum'. The Chairman of the Indian Wild Life Board in his final speech on December 1, 1952, said that this proposal deserves earnest consideration at the hands of the public and the several governments. The proposal is covered by Resolution No. 6 of the Board. A New Delhi press note of date March 5, 1953, announces the intended establishment of such a park between the Purana Kila and Humayun's Tomb. This, it is said, has the backing of the Prime Minister of India; and the Planning Commission so much to the fore at the present time has, it is stated, provisions for such parks throughout the country.

In the 'Delhi Memorandum' the suggestion is also made that places of religious pilgrimage such as Mount Abu, Mandu, Parasnath and the like should be formed into dual purpose parks; that is, parks both for protection of religious monuments and historic buildings and the wild life that is around them. In and around these places, being annually visited by millions of the people, much could be done to bring home to them the variety and beauty of the wild life that is their heritage from the past. They would learn and realise that it is their duty to pass to their descendants all that is now theirs to use and enjoy.

The management of India's Wild Life National Parks and Sanctuaries has been dealt with by Mr. E. P. Gee in our December 1952 *Journal*. The Compilation, here referred to, treats of these matters in detail; and in regard to parks of other kinds also—Peoples' Parks, Dual Purpose Parks and Zoological Parks.

TRADE, NETTING, POACHING AND SPORTSMANSHIP

An essential for the preservation of game is the prevention of its commercialization. Resolution 10 adopted by the Board of Control recommends that the netting of wild animals and birds should be stopped during 'close' seasons. This, if enforced, will be a something against the trappers and snarers. Those who have good knowledge of the question will realise how very difficult effective enforcement will be. The close season from February 15th to the end of September should protect all areas outside the forests. The 1938 U.P. Forest Department Schedule of close time for netting might with advantage be adopted by all States and Unions.

A measure which is essential in respect to trade is to recognize that flesh of wild animals and birds is not in these days necessary to human existence. Legislation is necessary to prohibit offering for sale, possessing for sale, or marketing in any way the hides, horns, flesh of any indigenous wild birds, or wild animals throughout the year. What possible objection can there be on religious or other grounds to a general law throughout the country to that effect? If half measures only are adopted the wild animals and birds now slaughtered for gain will gradually vanish. It can be said that the trade will, in course of time, put an end to itself through the extermination of all the creatures which support it!

There are two powerful enemies to wild life which need to be dealt with (1) Poaching through use of the motor vehicle, (2) Poaching through use of the electric torch. Unless these two forces of destruction are halted the larger wild life of India is doomed. Those shocking predators, the 'Mighty Jeep' and its many relatives are at work in many parts of India during the evenings and nights of most months in the year. The Game Laws and Rules should conform with the Excise Laws and give power to the convicting courts to order confiscation of any vehicle used to contravene the laws and rules. Why not? Unless this step is taken poaching through use of the motor vehicle will continue. Other countries have faced the facts; India should do the same.

In his speech at the final session, the Union Minister of Agriculture, Dr. Punjabrao Deshmukh, declared that 'we must inculcate a spirit of sportsmanship into our people'. That has reference to other aspects of shooting than the use of the motor vehicle at night.

The speeches delivered at the Mysore Session (Appendix 'A' of the Compilation) have in them much of interest, instruction and guidance.

WHAT OF THE FUTURE?

The foregoing is of the past and the present. What of the future? Most of us have more or less knowledge of what is being done in Bombay to guide and instruct the youth of to-day in nature study. Outside Bombay and in the rest of the country what is being done to educate the children in this respect? Nature study forms a part of the curriculum of primary and secondary schools. Is there a sufficient trained teaching staff? It is feared that the teaching staff are handicapped by being unfamiliar with their subject. Have they in sufficient quantity the necessary suitable books, charts, literature, lantern slides and so on? Some thirty years ago it was authoritatively stated that the Boy Scouts and Girl Guides have an unparalleled opportunity for arousing an interest and an active love of Nature in children. Is that great organization doing anything in this important matter?

It is a truism to say that the youth of to-day must be the conservationists of to-morrow. In 1930 the Governor of Bombay said that we should aim at teaching the children the value of wild life; in 1949 the Governor of Ceylon declared there is need for propaganda and education among the younger children in the schools to convince them that they will, and must be the future custodians of wild life.

Unless in their youth the children of the present generation are properly instructed how are they going to be any better than the past and present generations which have brought the wild life and the forests of this country to their present parlous state?

In some countries good work is being done in this matter of instruction of the children. Apart from European countries the movement has advanced in West Africa, in Uganda and Northern Rhodesia, to mention only a few. It is recognised that small game and birds have an educational value for nature study which is encouraged as much as possible in schools. Roads and rest camp accommodation is providing opportunities for school children to visit Reserves, and the heavy booking during the school holidays shows that advantage is being taken of the facilities provided.

At the present time—1953—the I.U.P.N. is making considerable efforts in the direction of education of the youth. Special lessons for the use of educators and of teachers and pupils in primary and secondary schools of a number of countries are being issued. 'In spite of its importance to mankind the theme of these lessons is little known or totally ignored by contemporary nations,' writes the Secretary-General. So India is not the only country apathetic in this vital matter. In the nature study movement lies the real interest that is the true protection of wild life and the forests of the future.

APPENDIX 'A'

List of references printed in the book, 'The Preservation of Wild Life—A Compendium' compiled and written by Lt.-Col. R. W. Burton and published in March 1953 with the financial assistance of His Highness the Maharaja of Mysore, Chairman of the Indian Board for Wild Life.

1. The Wild Animals of India and the Problem of Their Preservation.

   (a) Introductional Survey of the Indian Empire and the Problem.
   By S. H. Prater, O.B.E., C.M.Z.S., Curator, Bombay Natural History Society.

   (b) The Central Provinces (Madhya Pradesh).
   By A. A. Dunbar Brander, Late Conservator of Forests, Central Provinces. [Vol. 36 (4); 1933].

   (c) The Bombay Presidency (Bombay State).
   By G. Monteith, I.C.S. [Vol. 36 (4); 1933].

   (d) Assam.
   By A. J. W. Milroy, Conservator of Forests, Assam. [Vol. 37 (1); 1934].

(*e*) The United Provinces (Uttar Pradesh).
By F. W. Champion, Deputy Conservator of Forests. United Provinces [Vol. 37 (1); 1934].

(*f*) The Madras Presidency (Madras State).
By R. D. Richmond, I.F.S. (Retd.). [Vol. 38 (2); 1935].

(*g*) Comments on Mr. Richmond's Note.
By R. C. Morris, F.Z.S. [Vol. 38 (2); 1935].

(*h*) Mysore State.
By Major (Lt.-Col.) E. G. Phythian-Adams, O.B.E., F.Z.S. [Vol. 38 (2); 1935].

(*i*) Hyderabad State.
By Sálim A. Ali, M.B.O.U. [Vol. 38 (2); 1935].

2. Principles of Wild Life Conservation.
By Theodore Hubback, F.Z.S. [Vol. 40: 100-111 (1938)].

3. Wild Life Preservation in India—India's Vanishing Asset.
By Lt.-Col. R. W. Burton. [Vol. 47: 602-622 (1948)].

4. Preservation of Wild Life in India—Supplement to the above.
By Lt.-Col. R. W. Burton, I.A. (Retd.) [Vol. 48: 290-299 (1949)].

5. Wild Life Preservation—Birds.
By Lt.-Col. R. W. Burton, I.A. (Retd.) [Vol. 47: 778-780 (1948)].

6. Preservation of Wild Life.
By M. D. Chaturvedi, B.SC. (Oxon), I.F.S., Chief Conservator of Forests, and now Inspector-General of Forests and Vice-Chairman of the Indian Board for Wild Life. With Comment by Lt.-Col. R. W. Burton, I.A. [Vol. 48: 588-591 (1949)].

7. Nature Conservation, National Parks and Bio-aesthetic Planning in India (An Address to the Section of Botany, 36th Indian Science Congress, Allahabad, 1949). (abridged.)
By M. S. Randhawa, I.C.S., M.SC., F.N.I., Deputy Commissioner, Ambala (E. Punjab).

8. A Memorandum (42 paragraphs) dated 16th October 1950 submitted by Lt.-Col. R. W. Burton, to the Sub-Committee to be assembled at New Delhi to examine and suggest ways and means for setting up National Parks and Sanctuaries in India.

9. Editorials: *The Journal of the Bombay Natural History Society*. Game Preservation in India. [Vol. 32: 359-365 (1927)].

10. Jungle Memories.
By Major (Lt.-Col.) E. G. Phythian-Adams, O.B.E., F.Z.S., I.A. (Retd.) 'Conservation' at pp. 467-468, Vol. 50 (1952).

APPENDIX 'B'

RESOLUTIONS ADOPTED BY THE CENTRAL BOARD FOR WILD LIFE AT ITS FIRST SESSION HELD IN MYSORE FROM NOVEMBER 25TH TO DECEMBER 1ST, 1952.

Name

1. The Central Board for Wild Life recommends that its name be changed to 'Indian Board for Wild Life', so as to specify its precise territorial limits for international purpose.

Declaration of the Central Board for Wild life as an institution of national importance.

2. Whereas India's heritage of wild life is fast becoming a vanishing asset in respect of some of the country's notable animals, such as, lion, rhinoceros, tragopan, cheetah, etc.,

Whereas the preservation of the fauna of India and the prevention of the extinction of any species is a matter of great national importance, and

Whereas protection in balance with natural and human environment are also matters of urgent national importance,

(*i*) To devise ways and means for the conservation and control of wild life through co-ordinated legislative and practical measures, with particular reference to seasonal and regional closures and declaration of certain species of animals as 'protected' animals and prevention of indiscriminate killing ;

(*ii*) to sponsor the setting up of national parks, sanctuaries and zoological gardens;

(*iii*) to promote public interest in wild life and the need for its preservation in harmony with natural and human environment ;

(*iv*) to advise Government on policy in respect of export of living animals, trophies, skins, furs, feathers and other wild life products;

(*v*) to prevent cruelty to birds and beasts caught alive with or without injury ; and

(*vi*) to perform such other functions as are germane to the purpose for which the Board has been constituted.

The Central Board for Wild Life recommends to the Government of India that, despite the existence of entry 20 'Protection of wild animals and birds' in List II (State List) of the seventh Schedule to the Constitution of India, the Central Board for Wild Life, with the marginally noted functions assigned to it under the Ministry of Food and Agriculture Resolution F. 7-110-51-R. of the 4th April 1952 be declared by Parliament by Law to be an institution of national importance as envisaged in items 62 and 64 of List 1—Union List—of the VII Schedule to the Constitution more specially as the proper exercise of the functions of the Board will involve recourse to action under one or more of the following entries in the Union and concurrent Legislative Lists :—

List I—item 5. Arms, firearms, ammunition and explosives.

List I—item 13. Participation in the international conferences, associations and other bodies and implementing of decisions made thereat, e.g., the International Union for the Protection of Nature.

List I—item 41. Trade and commerce with foreign countries; import and export across customs frontiers—in so far as living animals, trophies, skins, furs, feathers and other wild life products are concerned.

List I—item 42. Inter-State Trade and Commerce with respect to matters specified against the preceding entry (No. 41).

List I—item 81. (Union List) Inter-State migration (of wild life).

List III—item 17. (Concurrent List) Prevention of cruelty to animals.

List III—item 29. (Concurrent List) Prevention of the extension from one State to another of infectious or contagious diseases or pests affecting men, animals or plants.

List III—item 33. (Concurrent List) Trade and Commerce in and the production, supply and distribution of the products of industries where the control of such industries by the Union is declared by Parliament by law to be expedient in the public interest.

[Sub-Section (2) of Article 246 enables Parliament to make laws with reference to any of the matters enumerated in List III.]

Amendment of the constitution of the Central Board for Wild Life.

3. Whereas the constitution of the Central Board for Wild Life set up by the Government of India requires elaboration and amplification with a view to devising ways and means for the proper fulfilment of its aims and objects,

The Central Board for Wild Life recommends :—

(*a*) that each State Government should be requested to set up a State Wild Life Board consisting of representatives of various organisations and interests to deal with the day-to-day administration of local Wild Life problems.

Note :—The co-ordination of the activities of the State Boards will be effected through the Central Board for Wild Life.

(*b*) that Honorary Regional Secretaries should be appointed as the Board's representatives to cover on its behalf the various regions in India.

Note :—Appointments of Honorary Regional Secretaries will be made by the Government of India and duly notified in the Gazette of India. Each Regional Secretary will maintain liaison between the Central Board and the State Boards. It will be necessary to make provision for the travelling allowance of the Regional Secretaries for the journeys performed by them in their respective regions in the discharge of their duties assigned to them by the Board.

(*c*) that Dr. S. L. Hora, Director, Zoological Survey of India, and President, National Institute of Sciences, India, should be appointed as the Honorary Secretary-General of the Board.

(*d*) that for the day-to-day administration, an Executive Committee consisting of the following be constituted :—

The Non-official Vice-Chairman. (Chairman)
The Regional Secretaries.
The Secretary-General.
The Secretary of the Central Board. (Secretary)

Note :—The Executive Committee will be vested by the Board with authority to function on its behalf in the disposal of day-to-day business.

(*e*) that the Constitution of the Board should be so amended as to cover the above recommendations.

Executive Committee.

4. Whereas it is necessary to provide the Executive Committee of the Board with authority to carry on the day-to-day business of the Board and to take action on its behalf while the Board is not in session,

The Central Board for Wild Life resolves :—

(*a*) that the Executive Committee is vested with full powers to take necessary action in pursuance of the objects of the Board to deal with the day-to-day business of the Board and to address the Central Government and other authorities on various matters concerning the business of the Board;

(*b*) that the Executive Committee will transact its business by circulation as far as possible and will meet at least once in 6 months;

(*c*) that the Executive Committee will frame bye-laws for the disposal of its own business as well as the business of the Board subject to the ratification of the Board;

(*d*) that the proceedings of the Executive Committee shall be circulated to the Members of the Board in the form of periodical bulletins;

(*e*) that in the event of a decision to be taken in respect of a State, the representative of the State concerned on the Board shall be co-opted; and

(*f*) that the Executive Committee is authorised to make verbal alterations in the language of the resolution to be presented to Government.

The Central Board for Wild Life resolves:—

Thanks to Mysore Government.

5. that its grateful appreciation of the generous arrangements made for holding its inaugural session at Mysore should be conveyed to the Government of Mysore.

In particular, the Board would like to convey its gratitude to His Highness the Rajpramukh for his unstinted hospitality and for the interest he has taken in the proceedings of the session.

The Board also acknowledges with thanks the assistance rendered by the Chief Conservator of Forests, Mysore, and his staff in organizing visits to various institutions and making arrangements for the delegates.

Protection of Nature and Wild Life.

6. Whereas the preservation of nature in its unspoiled state is deemed essential for its educative and aesthetic value;

Whereas wild life in India is progressively diminishing,

Whereas some of the wild animals have already become extinct or are on the verge of extinction, and

Whereas the maintenance of an equilibrium between the vegetable kingdom and the animal kingdom and among the animals themselves is of importance to mankind,

The Central Board for Wild Life recommends that the attention of the State governments should be drawn to the need for :—

(*a*) the creation of National Parks in conformity with the general objectives laid down by the International Union for the Protection of Nature and affiliated bodies,

provided that should a State create a National Park, the advice of the Central Board for Wild Life will be taken to ensure its national character.

Note :—The term 'National Park' for this purpose would generally denote an area dedicated by statute for all time, to conserve the scenery and natural and historical objects of national significance, to conserve wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations, with such modifications as local conditions may demand.

(*b*) the creation of Wild Life Sanctuaries (or Wild Life Refuges) of such size and in such numbers which the needs for the preservation of wild life, more particularly of the species which have become scarce or which are threatened with extinction, may demand.

Note:—1. The expression ' Wild Life Sanctuary ' shall denote an area constituted by the competent authority in which killing, hunting, shooting or capturing of any species of bird or animal is prohibited except by or under the control of the highest authority in the department responsible for the management of the Sanctuary. The boundaries and character of such a sanctuary will be kept sacrosanct as far as possible. Such sanctuaries should be made accessible to visitors.

2. While the management of sanctuaries does not involve suspension or restriction of normal forest operations, it would be generally desirable to set apart an area of 1 to about 25 square miles within a sanctuary where such operations may not be carried out, to ensure the nursing up of wild life undisturbed by human activities. Such sacrosanct areas may be declared as ' *Abhayaranya* ' i.e., a forest where animals could roam about without fear of man. Such a sanctuary within a sanctuary would also ensure the preservation of plant life unspoiled and undisturbed.

3. In the management of sanctuaries, control should be exercised over elements adverse to the maintenance of wild life, including destruction of vermin and predators. In the case of any difficulty, expert advice may be obtained from the Central Board for Wild Life.

4. In the event of a sanctuary being located in one State contiguous to a sanctuary in another State, the desirable co-ordination may be effected through the Central Board for Wild Life.

(*c*) imposing restrictions on the issue of shooting permits and by the prohibition of shooting in State Forests of a particular species for such periods as may be deemed necessary in order to attain the objectives in regard to the preservation of wild life.

Note:—Special ' preservation plots ' may be constituted where plants of medicinal value or species of special botanical interest may need to be preserved along with or without wild life.

(*d*) encouraging members of the public interested in wild life to assist in the preservation of wild life by appointing them as Honorary Wild Life Officers who will perform the duties and enjoy the powers and privileges of Forest Officers in respect of preservation of wild life delegated to them.

Note:—All the members of the Central and the State Wild Life Boards as well as Honorary Wild Life Officers should be issued with a badge of office and an identity card in consultation with the Central Board for Wild Life.

(*e*) the setting up of zoological parks for the purpose of entertainment, recreation and study of animal life.

Note 1:—These parks should provide ideal conditions for rescuing and multiplying any species on the verge of extinction.

2. A Zoological Park is different from a zoological garden, inasmuch as it provides space and secures conditions similar to those in the natural habitats for the housing of animals, which are not possible in zoological gardens.

(*f*) modelling the administration of zoological gardens of the various States along the lines of Alipore Zoo, Calcutta.

Note:—The maintenance of zoos at a high standard of efficiency is desirable, and advice in this respect may be obtained from the Honorary Secretary-General of the Central Board for Wild Life.

(*g*) declaring the following species as protected animals:—

(i) Indian Lion
(ii) Snow Leopard
(iii) Clouded Leopard
(iv) Cheetah
(v) Rhinoceros (all species)
(vi) The Indian Wild Ass
(vii) Kashmir Stag
(viii) Musk Deer
(ix) Brow-antlered Deer
(x) Pigmy Hog
(xi) Great Indian Bustard
(xii) Pink-headed Duck
(xiii) White-winged Wood Duck

Note:—This list is illustrative and not exhaustive and may have to be added to from time to time to suit local conditions. Legislation should be enacted where necessary to secure complete protection of these animals and birds which are on the verge of extinction.

Protection of the Lion.

7. Whereas the Indian lion, which not long ago was distributed throughout north-west India,

Whereas the Indian lion has now receded to the confines of Gir Forest in Kathiawar Peninsula, and whereas the Indian lion is an animal of national importance requiring rigorous protection,

The Central Board for Wild Life

Views with great alarm the dangers attendant upon concentrating the remnant lions in a single locality and not immune from epidemic and other unforeseen calamities;

Recommends that an additional locality as a Sanctuary for the lions in a suitable area should be developed. In the selection of this locality, the original range and environment of the lion shall be taken into consideration.

And Requests that the attention of the Government of Saurashtra should be invited to the need for associating the Central Board for Wild Life in the management of the lions of the Gir Forest.

Trading in Trophies, Skins, Furs, Feathers and Flesh.

8. Whereas unrestricted trading in trophies, skins, furs, feathers and flesh is detrimental to the wild life resources of the country,

The Central Board for Wild Life Recommends:—

(*a*) that the export of trophies, as defined in the Bombay Wild Animals and Wild Birds Protection Act 1951 (xxiv of 1951) should be prohibited except in cases which are covered by a *Certificate of Ownership* issued by the prescribed authority of the Central or State Governments such as Forest or Revenue Officers, etc. or whose ownership is otherwise established.

Note:—This provision will not apply to the re-export of trophies sent to India for finishing on the production of a certificate of the owner.

(*b*) that legislative control of internal trade in trophies should, for the present, await the experience to be gained in the Bombay State where legislation in this respect is being brought into force shortly,

(*c*) that, in the meanwhile, in order to discourage trading in trophies inside the country and to prohibit (*a*) the netting of birds and animals during 'close' periods, (*b*) their sale, (*c*) the sale of venison, (*d*) the sale of flesh and parts of other wild animals, the Government of India should invite the attention of the State Governments to the advisability of enforcing the provisions of Act VIII of 1912, as amended from time to time, or such other legislation as might have been enacted or extended for the purpose.

Prevention of cruelty to animals.

9. Whereas in the interests of wild life, and for humane reasons, it is necessary to prevent cruelty to animals and birds during captivity and transit,

The Central Board for Wild Life recommends

that the cooperation of the Society for the Prevention of Cruelty to Animals (S.P.C.A.) should be sought in this connection and that Honorary Wild Life Officers in every centre be requested to report all cases of cruelty to animals and birds in captivity and during transit.

Netting of wild birds and animals.

10. Whereas extensive netting of wild animals and birds is prejudicial to the maintenance of the Balance of Nature and is detrimental to the wild life of the country,

The Central Board for Wild Life recommends

that the netting of wild animals and birds should be stopped during 'close' seasons and that no exemptions should be permitted on grounds of tribal or caste customs, livelihood, profession or usage.

Export and Import of living animals and birds.

11. Whereas the unrestricted export of living animals and birds tends to deplete the fauna of the country, and

Whereas the unrestricted import of animals and birds is not in the interest of local fauna,

The Central Board for Wild Life recommends:—

(*a*) that the Chief Controller of Imports and Exports be requested to fix the annual limits for the *export* of each valuable species of wild life to zoos, scientific institutions and circuses outside India on the recommendation of the Secretary-General of the Board,

(*b*) that all requests for *imports* of living specimens of wild life by zoos, scientific institutions and circuses in India should be routed through the Honorary Secretary-General of the Board,

(*c*) that the *excise duty* to be levied on the export of animals for circuses should be double the duty levied on animals intended for *bona fide* zoos and scientific institutions,

provided that gifts and exchanges between *bona fide* zoos be exempt from such duties,

(*d*) that the State Governments be requested to give priority to the requirements of zoos in India in respect of species of wild life over the requirements of foreign zoos, provided that the restrictions contemplated in the aforesaid clauses shall not apply to exports of species classified as 'vermin'.

Note:—The phrase 'vermin' is defined in the Bombay Wild Animals and Wild Birds Protection Act (XXIV of 1951) as 'any animal or bird specified in Schedule I and includes any animal or bird declared to be vermin under Section 18'.

'Close' Season.

12. Whereas owing to lack of uniformity in the periods prescribed by different State Governments as 'close' seasons, it is difficult for the Transport Authorities to keep a check on 'close' season offences,

The Central Board for Wild Life recommends

that movements of living birds be prohibited from April 1st to September 30th which, for all practical purposes, will be treated as 'close' season for purposes of transport.

Note:—This restriction will not apply to movements for *bona fide* purposes, e.g., exchange of specimens by zoos and transport of birds by circuses, etc.

Compilation of statistics.

13. Whereas it is essential for the Central Board to maintain statistics of species of wild life,

The Central Board for Wild Life recommends

that all State Governments be requested to furnish information on the following points to its Secretary-General:—

(*a*) surplus species held by their zoos for disposal,

(*b*) species required by their zoos, and

(*c*) animals that can be captured in their forests.

Symposiums

14. Whereas it is necessary to focus attention on problems of educating the public on the value of wild life, and

Whereas zoos and national parks are institutions for such education,

The Central Board for Wild Life recommends

that symposiums should be held at an early date on the needs and requirements of

(*a*) Indian Zoos and

(*b*) management of National Parks and Sanctuaries so as to assist in the formulation of policies in regard to the maintenance of wild life exhibits in the Zoos and the management of National Parks and Sanctuaries.

Co-operation of public in enforcement of measures for the protection of Wild Life.

15. Whereas it is necessary to secure public co-operation in the enforcement of measures for the protection of wild life,

The Central Board for Wild Life recommends:—

(*a*) that members of the public interested in Nature should be invited to become *Honorary Correspondents* to the Board in matters relating to wild life; and

(*b*) that members of the Board should be appointed as *Honorary Wild Life Officers* on behalf of the Board in respect of the resolutions and recommendations passed and such instructions as may be issued from time to time by the Board.

Wild Life Legislation.

16. Whereas it is necessary to preserve wild life in the country as a whole.

Whereas the existing machinery for the protection of wild life in areas outside the purview of the Indian Forest Act XVI of 1927 or adaptations thereof, is inadequate, and

Whereas the protection afforded to wild life in areas within the purview of the Indian Forest Act XVI of 1927, or adaptations thereof, requires strengthening,

The Central Board for Wild Life recommends :—

(*a*) that necessary legislation be enacted at an early date by the Centre or the States as the case may be.

Note:—The attention of State governments is invited to the existing legislation for the protection of wild life in various States and, in particular, to the 'Bombay Wild Animals and Wild Birds Protection Act, Act No. XXIV of 1951' and the Rules framed thereunder.

'Close' seasons, illicit shooting, etc.

17. Whereas there is reason to believe that there is need for the amendment of existing 'close' seasons observed in respect of birds and animals,

Whereas the list of animals and birds now treated as vermin needs re-examination with a view to limiting it to only those animals and birds which should be kept in check,

Whereas in some parts of the country there is wholesale destruction of wild life with the help of dogs,

Whereas shooting from vehicles, with or without blinding spot or head lights, shooting with torches, shooting over salt licks and water holes, destroying animals by using poisons, explosives and poisoned weapons, catching animals and birds by nets, traps, pits, snares, etc., and killing animals by driving them in snow or by fire require to be discouraged in the interests of the preservation of wild life, and

Whereas the use of buck-shot wounds rather than kills animals,

The Central Board for Wild Life recommends:—

(*a*) that States do review, in consultation with the Central Board for Wild Life, and, if possible with their contiguous States, their 'close' seasons for the various animals and birds to be protected,

(*b*) that States should re-examine their lists of 'vermin' from time to time to ensure that only harmful species are so classified, and

(*c*) that the attention of State governments be invited to the urgent need for devising ways and means and of adopting such measures, including enactment of legislation, to discourage if not to prohibit, these practices in the interests of wild life.

Crop protection guns.

18. Whereas indiscriminate slaughter of wild life is often indulged in with the aid of guns ostensibly held for crop protection,

The Central Board for Wild Life recommends :—

(*a*) that ways and means be devised to ensure that guns issued for crop protection are used only for the protection of standing crops and that the use of such guns for hunting or shooting should be prohibited unless the licensee secures such other licences as are prescribed, (*b*) that the quantity and type of ammunition available to the holders of such guns should be restricted by the licensing authorities to such as is required for protection of crops only.

Note:—Licences should be generally issued for single-barrel guns only.

Buffer Belts around Sanctuaries.

19. Whereas much destruction of wild life goes on in areas contiguous to Sanctuaries, and

Whereas cattle-borne diseases are spread in such sanctuaries by domestic cattle from the surrounding areas,

The Central Board for Wild Life recommends

that buffer belts of sufficient width be declared around all sanctuaries within which no shooting, other than that required for legitimate crop protection, will be permitted and within which no professional graziers will be allowed to establish their cattle-pens.

Inoculation against cattle-borne diseases.

20. Whereas many preventable cattle-borne diseases among herbivorous wild animals result from contact with infected domestic cattle in the neighbourhood of 'forests',

The Central Board for Wild Life recommends

that State governments be requested to inoculate systematically and periodically domestic cattle in the neighbourhood of national parks, sanctuaries and reserves where and when necessary.

Publicity.

21. Whereas insufficient use is being made at present of the existing facilities of publicity afforded by the Press, Screen and Radio, for wild life protection,

The Central Board for Wild Life recommends:—

(*a*) that adequate publicity material be issued from time to time by the respective Central and State Publicity Departments in close collaboration with Forest Departments and other organizations,

(*b*) that enthusiasts be approached to give publicity to wild life,

(*c*) that documentary films dealing with various aspects of wild life be produced by Governments in consultation with the Central or State Boards for Wild Life for exhibition in both urban and rural areas,

(*d*) that amateur cinema-photography of wild life be encouraged, and (*e*) that the All-India Radio be requested to afford special facilities for wild life broadcasts.

Education.

22. Whereas there is general lack of knowledge regarding conservation of nature and the value of wild life, and

Whereas it is essential to educate public opinion in matters of wild life,

The Central Board for Wild Life recommends

that special steps be taken to popularise wild life by introducing stories in school text-books, by producing attractive charts, by organising special lectures and through the establishment of zoos and zoological parks in the neighbourhood of large cities.

Liaison. **23.** Whereas for the purposes of education and publicity co-ordination of such departments as Forest, Agriculture, Horticulture, Scientific Research, Transportation (Tourist), and Information and Broadcasting is essential,

The Central Board for Wild Life recommends

that steps be taken through the Central and State Wild Life Boards to co-ordinate the activities of all connected departments in matters of management, publicity and education concerning wild life.

NOTES ON FISHES FROM MAHABLESHWAR AND WAI, (SATARA DISTRICT, BOMBAY STATE)

BY

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(*From the Laboratories of the Zoological Survey of India*)

(*With one plate and four text figures*)

INTRODUCTION

In April 1952, at the suggestion of Dr. S. L. Hora, I received an invitation from the authorities of the Bombay Natural History Society to visit Mahableshwar along with a party from the Society for an investigation of the fauna of that place. This invitation was readily accepted, especially as I was setting out on a fish survey tour to the northern parts of the Western Ghats and Kathiawar. Since Annandale's work on the fauna of certain hill-streams in the Bombay State (Annandale, 1919), no fish collection seems to have been reported from the Satara District[1]. The notes embodied in this paper are based on collections made in the course of the tour from Mahableshwar and from Wai on the Krishna River, about 20 miles east of Mahableshwar lying on the Mahableshwar-Poona road. The main purpose of the visit to Mahableshwar was to investigate the fauna of the famous 'Robbers' Cave', and while there opportunity was also taken to make collections from the streams in and around the hill-station. Among the fishes collected one species has proved new to science and is described here.

NOTES ON LOCALITIES

Situated 17°56'N. and 73°40'E., Mahableshwar, with a general elevation of over 4,500 feet, receives very heavy rainfall annually, averaging over 290 inches. A number of streams originate from the hill-sides which ultimately grow into four main rivers, the Krishna, the Yenna and the Koyna flowing to the east, and the Savitri flowing to the west. In April, most of the smaller streams had dried up, but collections were made mainly from the Lake, Yenna River, a pool in a dried stream bed close to the Yenna Falls and from 'Robbers' Cave'. The lake on the hill-top, which has a surface area of about 30 acres, is fed by perennial springs and has water all round the year. From a bog below the lake, the Yenna River originates, first as a small streamlet, growing larger as it winds its way touching a number of gardens. The stream bed is mostly rocky and collections were made from the stream from its commencement upto the Yenna Falls.

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[1] Kulkarni, C. V. (1952, *Rec. Ind. Mus.*, xlix, pp. 231-238) reports the discovery of a new genus of schilbeid catfishes from the Krishna River near Islampur, Satara District and Panchganga River near Kolhapur, Bombay State.

Though there are a large number of caves in India, unfortunately our knowledge of the fauna that they may possess is very meagre. Reviewing our knowledge of the zoology of the caves of Burma and Malaya Peninsula, Annandale and Gravely (1914) drew attention to the fact that the fauna of the caves of this region was, as a whole, far less specialised than that of the caves of Europe and North America. In India, this was well exemplified by the investigations of the fauna of the Siju Cave, Garo Hills, Assam, where a majority of the animals collected belonged to species which occurred usually outside the cave, and the few species which did exhibit any adaptation to cave life were only partially or incompletely modified. Reporting on the fishes collected from the Siju Cave, Hora (1924) cited two instances of partial colour loss, one in a loach, *Nemachilus* sp., and another in one specimen of *Ophiocephalus gachua* Hamilton, while all the other six species of fish collected from the cave showed normal colouration. Our visit to 'Robbers' Cave', which lies about four miles south east of Mahableshwar, was fruitful in that some interesting observations were made on the fish life in the cave. Of course, we were disappointed to a certain measure in our hopes that the water inside the cave would yield species of great zoological interest, but all the same we were able to collect a number of specimens of one species of fish, *Nemachilus evezardi* Day, which in its loss of colouration showed partial adaptation to cavernicolous conditions of life. Notes on this loach are given at the end (*vide infra*, p. 588). From Hora's observations on the fish fauna of the Siju Cave and the present investigations of 'Robbers' Cave', it would seem that loaches of the *Nemachilus* type, which usually find their way even to the very head-waters of hill-streams, could, when they are isolated in caves, easily adapt themselves to such environmental conditions.

The topography of the cave resembles that of a tunnel which ends blindly. It is about a hundred feet long and about ten feet wide at the mouth and in the interior the passage is about eight to ten feet high and about twelve feet broad, while at the farther end it is much narrower, the roof being very low. In recent years, the roof a few feet from the mouth had fallen down, thus permitting entrance of light that way also. The whole cavern pervades with the nauseating smell of bats which were found in hundreds. The air inside the cave was also very stuffy and the passage to the interior was made difficult by swarms of bats and bat-parasites. Our visit was at a time when the water level was at its lowest and it was found stagnant confined to two sections of the cavern, both being separated by a few feet of slabs and boulders which had fallen from the roof, and remained slightly higher than the water level. The first stretch of water which was about 2½ feet deep for the first 30 feet or so from the second entrance was thoroughly polluted by bat-guano which formed a thick bottom deposit as well as a scum on the surface. Even after repeated nettings we could not obtain any fish or other aquatic organisms from this stretch. The loach, *N. evezardi*, was obtained from the farther end of the cave where the water was clearer, less deep, and was spring-fed. Mr. Humayun Abdulali, who was with us and had earlier visited the cave after the monsoons, said that there usually is a little outflow of water at that time as the level of water inside the cave was considerably high making it even more difficult to wade through to the farther end. Much of the deposits of bat-guano is washed out at this time. Such an outflow of water from the cave would naturally help in the immigration of loaches from the neighbouring watershed to the cave.

The remaining collections were made from the Krishna River at Wai. The river is very rocky just below the bridge at Wai, and its right bank at this place is lined for about half a mile by temple steps. Being summer, the flow of water was not so great and collections were made from this section of the river as well as from the upper course of the river where the banks are rather low and overhung with grass and trees.

In the following table are listed the species and the total number of each, collected from different localities. For convenience, in the table the localities are numbered as (1) Lake at Mahableshwar, (2) Yenna River upto Yenna Falls, (3) Pool in dried stream bed close to Yenna Falls, (4) Robbers' Cave, Mahableshwar and (5) Krishna River at Wai.

List of species	No. of specimens collected	Localities				
		1	2	3	4	5
Order Cypriniformes.						
Division Cyprini.						
Suborder Cyprinoidei.						
Family Cyprinidae.						
Subfamily Rasborinae.						
Barilius barna (Hamilton)	14	–	–	–	–	×
Barilius bendelisis (Hamilton)	4	–	–	–	–	×
Rasbora daniconius (Hamilton).	3	–	×	–	–	–
Subfamily Cyprininae.						
Puntius jerdoni var. *maciveri* (Annandale)	15	–	–	–	–	×
Puntius kolus (Sykes)	1	–	–	–	–	×
Puntius sahyadriensis sp. nov.	102	–	×	–	–	–
Puntius ticto Hamilton	22	–	×	–	–	×
Tor mussullah (Sykes)	5	×	–	–	–	×
Subfamily Garrinae.						
Garra mullya (Sykes)	4	–	×	–	–	×
Parapsilorhynchus tentaculatus (Annandale)	18	–	–	×	–	–
Family Cobitidae.						
Subfamily Nemachilinae.						
Nemachilus evezardi Day	32	–	–	×	×	–
Nemachilus denisonii Day	7	–	–	–	–	×
Order Ophiocephaliformes.						
Family Ophiocephalidae.						
Ophiocephalus gachua Hamilton	1	–	×	–	–	–
Ophiocephalus punctatus Bloch.	27	–	×	–	–	×

In addition to the fishes, the collection also includes two genera of Mollusca (*Lamellidens marginalis* (Lamarck) and *Parreysia cylindrica* Annandale, from the Krishna River at Wai), four genera of insects (*Oreitochilus* sp., and *Dinentus indicus* Abue, of the family Gyrinidae and *Hydaticus uittatus* Fabre, and *Rantus* sp. of the family Dytiscidae), a crustacean *Palemon kistnensis* Tiwari (both from Wai and Mahableshwar) and a number of frogs, tadpoles and three species of bats.

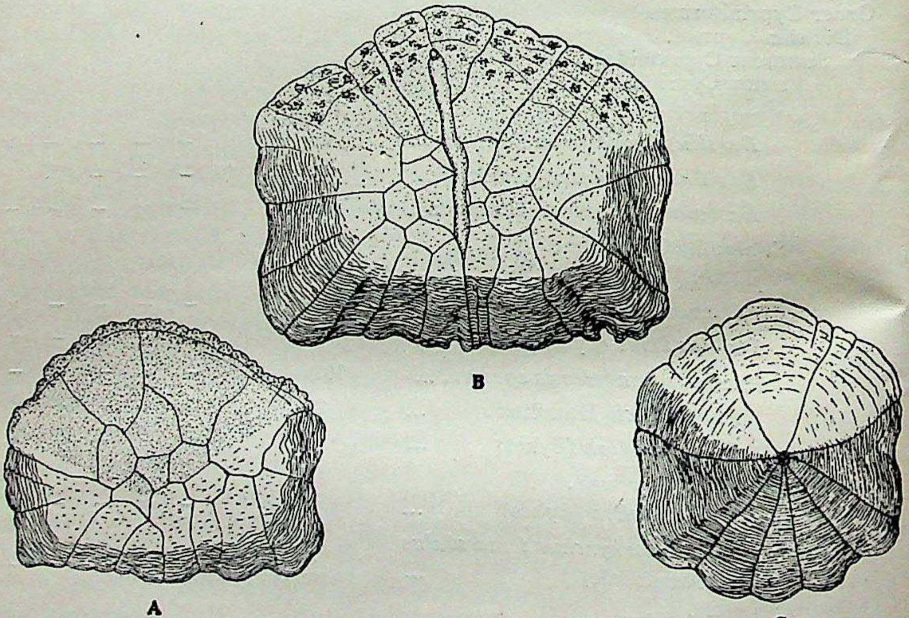
NOTES ON CERTAIN SPECIES

Most of the 14 species of fish mentioned in the table above are fairly common and have a wide distribution. A description of the new species *Puntius sahyadriensis* and notes on *Nemachilus evezardi* Day are given below:

Puntius sahyadriensis[1], sp. nov.

D.3/8-9; P.13; V.9; A.3/5; C.19; L.1.23-24.

Puntius sahyadriensis is a small well-built carp in which the dorsal profile is slightly more arched than the ventral. The length of the head is contained about 4.3 to 5.2 in the total and 3 to 4 in the standard length. The depth of the body is contained 2.6 to 3 times in the standard length and is also equal to or more than the length of



Text-fig. 1. Scales of *Puntius sahyadriensis* sp. nov. (A) scale from body below the dorsal fin ×10. (B) scale from the lateral line ×10. (C) scale from the caudal peduncle ×10.

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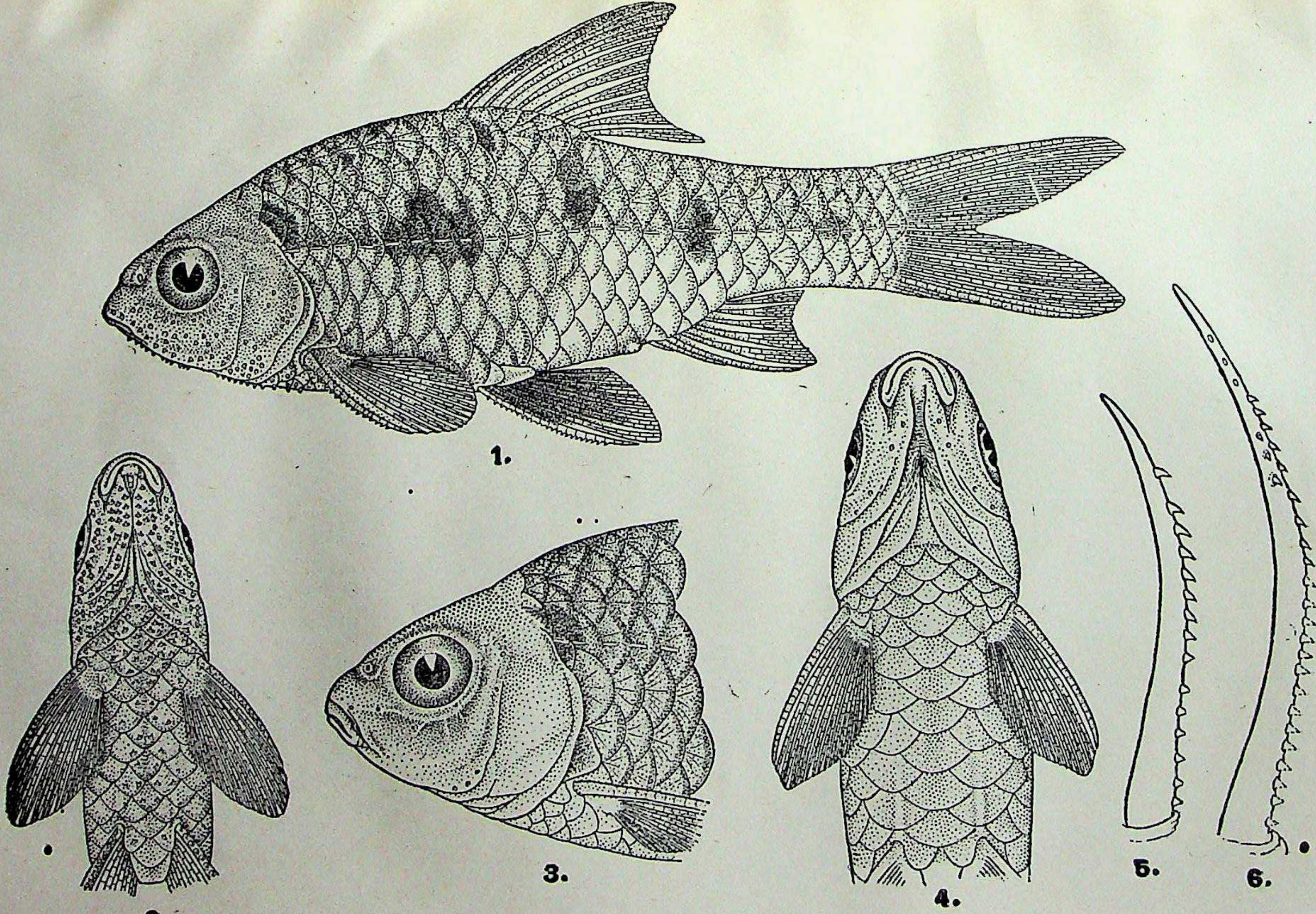
[1] The specific name *sahyadriensis* is derived from the vernacular name 'Sahyadri', which denotes the Western Ghats.



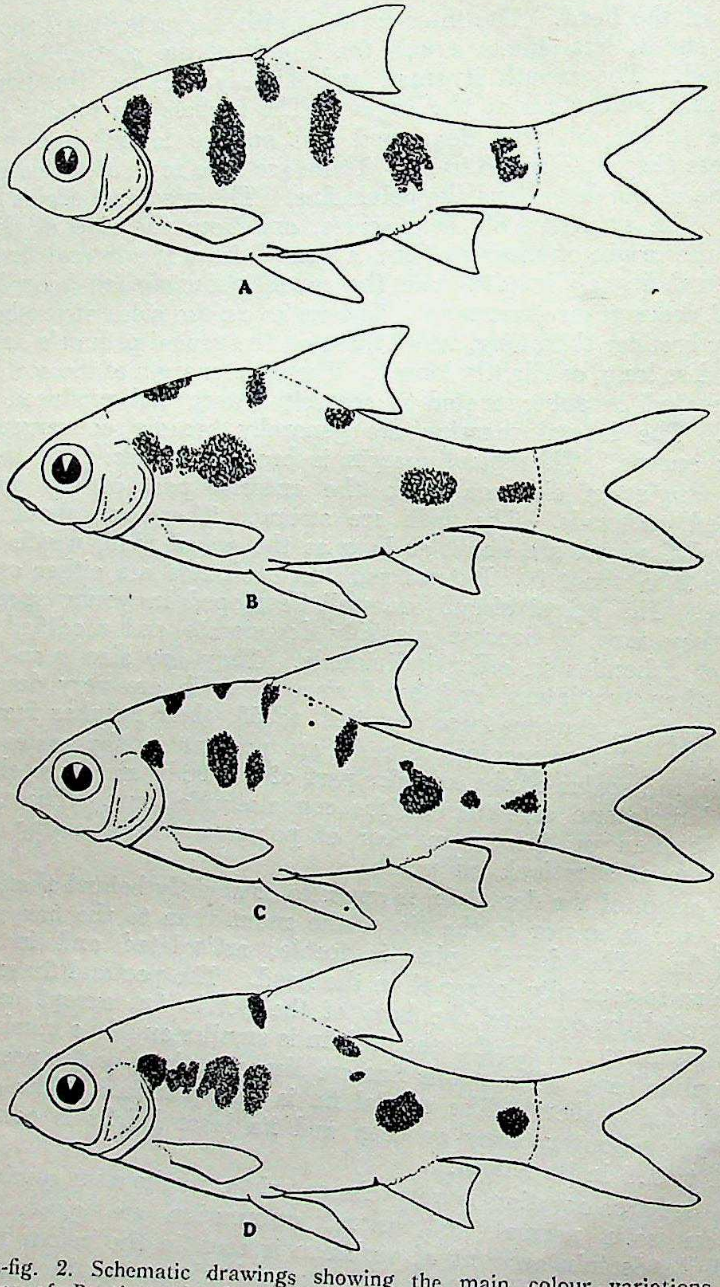
Puntius sahyadriensis, sp. nov.
(For explanation see p. 589)

the caudal. The head is more or less blunt, the length of the snout being less than the diameter of the eye. The eyes are large, with free orbital margins and are situated more towards the anterior half of the head. The diameter of the eye is contained 2.75 to 3.5 in the length of the head. The inter-orbital width is greater than the length of the snout, but almost equals the length of the post-orbital part of the head. The mouth is small and slightly oblique, the lips being fleshy and continuous at the angles. The barbels are totally absent.

The scales are well developed and on the lateral line which is complete they number 23 to 24. There are nine rows of scales between the base of the dorsal and the pelvic fins. The predorsal scales number eight. The structure of three scales, one from the side of the body below the origin of the dorsal fin, a second from the lateral line below the dorsal fin and a third from the caudal peduncle are figured and a general description given here. The scales on the sides of the body are slightly broader than long, while those on the caudal peduncle are about as broad as long, or slightly longer. The basal margin of the scale which is truncated or subtruncated is coarsely wavey and produced at the angles. The lateral margins are generally broadly convergent with convex curves. The apical margin is broadly rounded and the basi-lateral angles of the scales on the anterior part of the body are produced outwards. The radii are strong. There are about 5 to 8 basal radii, which are about as long as the apical radii, which in turn number 2 to about 6. Lateral radii on each side are either one, two or none. The apical circuli are well developed in young specimens, while they tend to become partially degenerate and modified into a series of tubercles in older individuals. They are also more widely spaced than the lateral and basal circuli, which are very dense and closely packed, ranging from about 10 to 55, their number increasing posteriorly. A few incomplete radii are present in the scales. The nuclei in the scales of the anterior part of the body are more elongate in the dorsolateral axis than in the cephalocaudal axis. The nucleus is also broken up into a number of polygonal areas giving it the appearance of a reticulated patch.

The origin of the dorsal fin is opposite or slightly behind that of the pelvics, and is nearer to the tip of the snout than to the base of the caudal fin. The dorsal spine is feeble, articulated and in larger specimens is generally longer than the head. The pectoral fin extends upto or slightly overlaps the base of the pelvic fin, except in large female specimens where the pectoral fin is smaller and falls much short of the pelvic base. The pelvic fins are almost as long as the pectorals. The anal fin is short. The caudal fin is deeply forked. The caudal peduncle is about as long as deep and its least height is contained about 1 to 1.5 in its length.

The body colouration is very characteristic in the new species and notes on both normal and sexual colouration are given below. Normally a certain amount of variation is seen in the colour pattern which cannot be strictly attributed to growth alone, for the variations figured are from specimens of about the same size (Text-fig. 2, A-D). The typical pattern seen in most of the specimens examined is that in which there are seven vertical dark blotches on the sides of the body (Text-fig. 2, A). Of these one is just above the gill-opening; a second on the lateral line in front of the commencement of the dorsal fin; a third dorso-laterally placed midway between the occiput and the commencement of the dorsal fin; a fourth just below the origin of the



Text-fig. 2. Schematic drawings showing the main colour variations seen in specimens of *Puntius sahyadriensis* sp. nov. ×1½.

dorsal fin, but not extending upto the lateral line; a fifth below the posterior part of the base of the dorsal fin; a sixth on the lateral line above the anal fin and a seventh just in front of the base of the caudal fin, on the caudal peduncle. The scales generally have a darker margin.

During the breeding season, both the males and females show brighter colouration, but the vertical blotches on the sides of the body fall more or less within the limits of the variations already indicated in Text-figure 2. In addition, in the female specimens the body is reddish brown throughout, being darker in the anterior and upper half of the body and lighter on the ventral surface. The pelvics, which are black, are tipped with white and the outer ray of the dorsal is also coloured black. In the males, the general body colour is lighter, especially on the ventral surface and posterior part of the body. The pelvics are coloured totally black or are black tipped with white. The outer ray of the dorsal is also coloured black, while the pectoral and the anal fins are slightly tinged dark in some specimens.

Secondary sexual characters seen in the male are the presence of numerous tubercles on the snout, the lower sides of the head and the ventral surface as far back as the pelvic base (Plate 1, figs. 1 and 2). Also the skin on the outer ray of the pectoral and pelvic fins bear a row of numerous short spine-like tubercles. A second row of smaller tubercles are present on the outer half of the first ray of the pelvic fin (Plate 1, figs. 5 and 6).

Bionomics: The gut contents of over 30 specimens of *P. sahyadriensis*, ranging from 25 mm. to 70 mm. were examined and it was found that they feed mainly on algae (*Spirogyra* sp.) which formed about 90% of the food. The rest was composed of sand particles and some digested pulpy matter. It would thus appear that the fish may prove to be very useful for the control of algae and thus indirectly also help to eradicate mosquito larvae. Its beautiful colouration and the abundance in which it is found in the streams in Mahableshwar, a place so close to Bombay, should also make it a very good indigenous aquarium fish.

Affinities: In the absence of barbels, the nature of the dorsal spine, the number of lateral line scales, the colouration, etc., *Puntius sahyadriensis*, can be easily distinguished from other species of *Puntius*, such as *P. melanampyx* (Day), *P. arulius* (Jerdon), *P. nigrofasciatus* (Günther), *P. gelius* (Hamilton), etc. From *P. narayani* (Hora) in which species also the barbels are absent, it differs in the following important characters:

Puntius narayani (Hora).	*Puntius sahyadriensis* sp. nov.
1. Lateral line scales 22	Lateral line scales 23-24.
2. Commencement of dorsal in advance of origin of pelvics.	Commencement of dorsal opposite or slightly behind origin of pelvics.
3. *Colouration*: 3 vertical blotches on sides of body.	At least 7 vertical blotches on sides of body.

In addition to these, the head in *P. narayani* is contained only 4 times in the standard length, while in the new species it is 3 to 4 times. Also in the former, the depth of the body is contained 2.5 times in the standard length while in the latter it is 2.6 to 3 times. From distributional records it would seem that *P. sahyadriensis* is replaced further south in the Western Ghats by *P. narayani*, the more deep bodied form with a lesser number of scales along the lateral line, to which it evinces greater affinity than to other species of *Puntius* from Peninsular India.

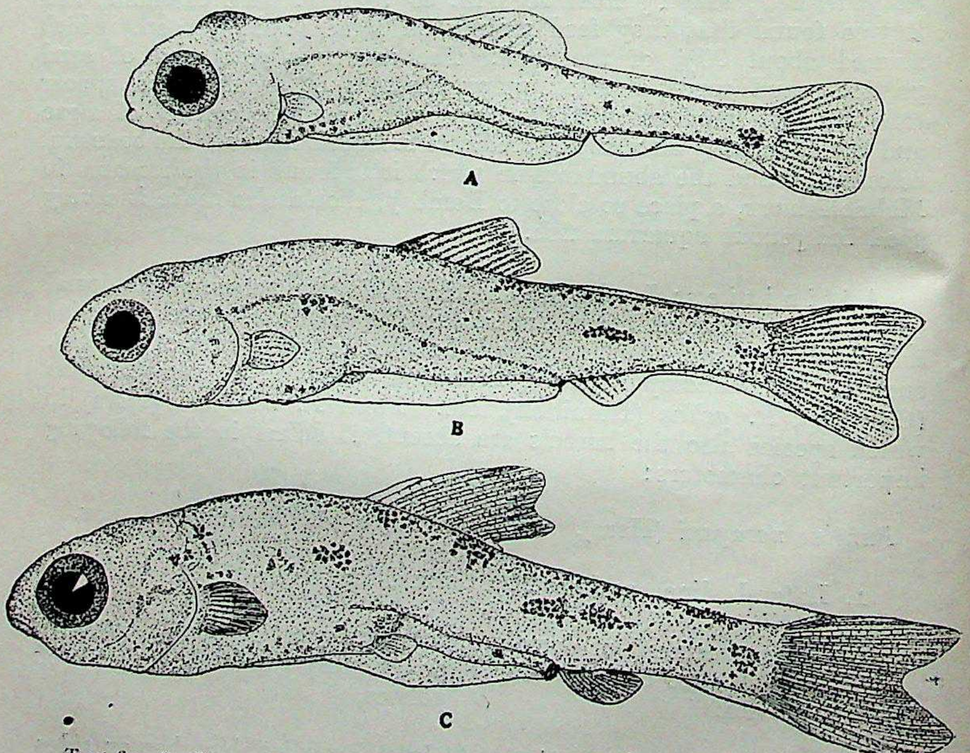
Type specimen: No. F. 687/2.

The type as well as the co-types are preserved in the collection of the Zoological Survey of India.

Type locality: Yenna River, Mahableshwar, Satara District, Bombay State.

Notes on Growth: A large number of post-larvae of *P. sahyadriensis*, ranging upwards from 6 mm., were collected from the Yenna River and notes on some of the early post-larvel stages are given below.

6 mm. stage: (Text-figure 3, A) By the time the larva is 6 mm. long the yolk is very much reduced and is represented as a few black pigment spots on the ventral side. The larval fin-fold is entire and



Text-fig. 3. Three early post-larval stages in the development of *Puntius sahyadriensis* sp. nov. (A) 6 mm. stage ×15½. (B) 7.5 mm. stage ×14 (C) 9 mm. stage ×13.

in the dorsal fin which appears as a slightly raised portion of the fin-fold, the rudiments of fin rays are perceptible. The caudal fin rays are better formed but not distinct. The anal fin is seen as a slightly raised basally thickened portion of the larval fin-fold. Fin rays are perceptible in the pectoral fin which is slightly pedunculate. The eyes are comparatively large, while the snout is considerably shorter. Black pigment spots begin to appear on the dorsal surface and a few on the caudal peduncle.

7.5 mm. stage: (Text-figure 3, B). The yolk is almost completely absorbed and the last trace of 'yolk chromatophores' is seen as three black spots on the ventral side. The dorsal fin rays are gradually formed and just behind the posterior limit of the dorsal fin the larval fin-fold is completely cut off. The caudal fin has become slightly lunate and the fin rays are better developed. In the anal fin, rudiments of four finrays are seen. The pre-anal fold extending from behind the pectorals to the anus persists. The first indication of the pelvic fin is seen as a rudimentary thick portion which in origin is completely ahead of the point of origin of the dorsal fin. The posterior margin of the operculum is slightly more curved than in the previous stage. More pigment spots have appeared on the sides of the body, and five small patches can be made out, the first at the origin of the dorsal fin, a second posterior to the base of the dorsal fin, a third at the base of the caudal fin, a fourth above the anal fin and a fifth in the region above the air-bladder, above and behind the pectorals. Two pigment spots are also present just above the gill-opening and a few on the inner surface of the operculum.

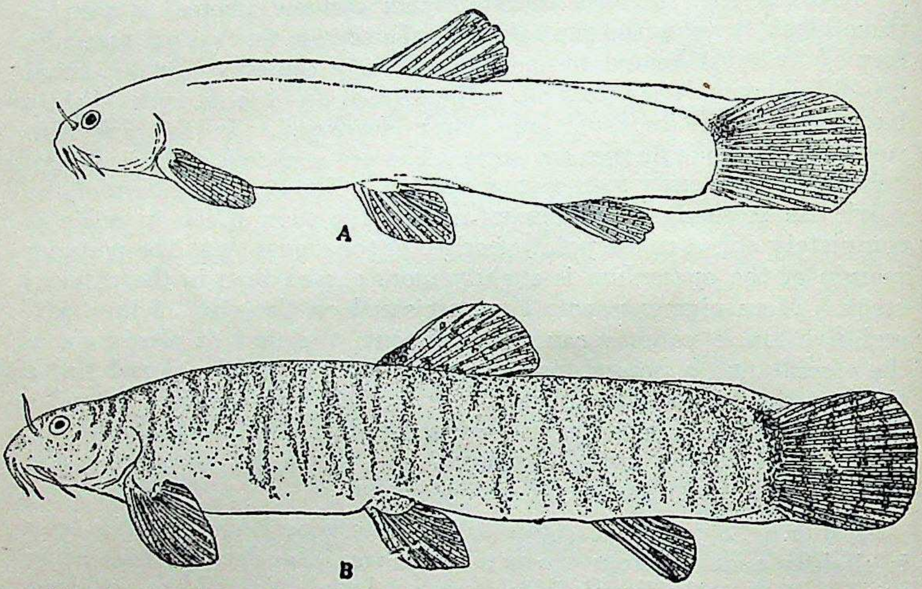
9 mm. stage: (Text-figure 3, C). The general shape of the body is slightly changed from the previous stages, the dorsal profile being more arched. The larval fin-fold on the dorsal side and the post-anal part are much atrophied. The dorsal and caudal finrays are well defined. The anal fin is free from the larval fin-fold and six finrays can be made out in it. The caudal fin is slightly forked. The preanal fin-fold shows a tendency to atrophy. The fin rays in the pectorals are well defined, while those in the pelvics are rudimentary. More pigment spots have appeared on the sides of the body. The first indications of a few scales are seen just above the operculum in the region of the nape. Under the microscope food particles can be made out in the alimentary canal.

11 mm. stage: The dorsal profile is more arched than the ventral profile. The larval fin-fold has almost completely atrophied. The snout is slightly more elongate and the outer margin of the operculum is more curved. The finrays are well developed in all the fins. Scales appear on the nape and on the caudal peduncle. More pigment spots are seen and the colour pattern is better laid out.

13 mm. stage: The scales are well developed all over the body. The lateral line is faintly marked. By this stage the larva assumes the shape characteristic of the adults and thus passes on from the early postlarval phase to the late postlarval phase leading gradually on to the juvenile fish.

Nemachilus evezardi Day

Of the 32 specimens of *N. evezardi* collected on the tour, 23 were from inside 'Robbers' Cave'. In all the latter specimens, the colour was considerably changed and in no other respect did they exhibit any adaptation to life in perpetual darkness. Normally the fish shows a very bright colour pattern, but in those collected from the cavern the colour was almost entirely absent and in one specimen except for a faint blotch on the upper portion of the base of the caudal, there were no colour markings on the body at all (Text-figure 4, A). In the specimens which varied from 18 to 55 mm. in total length, the smaller ones exhibited better colour markings than the larger ones, thereby showing that the loss of colour had taken place after the fish had become isolated in the cave. Many of the larger fish collected were gravid with eggs, which shows either the possibility of the fish breeding in the cave or breeding in the streams lower down, finding access to them through the outflow of water from the cave during the monsoon. From the low degree of specialization of its fauna it would also seem that the cave is comparatively of recent origin.



Text-fig. 4. *Nemachilus evezardi* Day. (A) specimen from 'Robbers' Cave', Mahableshwar, showing only a faint dark blotch at the upper portion of the base of the caudal fin. ×$2\frac{1}{8}$. (B) specimen from Yenna River showing normal colouration ×$2\frac{1}{8}$.

ACKNOWLEDGMENT

I am deeply indebted to Dr. S. L. Hora, Director, Zoological Survey of India, for his helpful suggestions and guidance in the preparation of this paper. I am also very grateful to both Mr. Sálim Ali and Mr. Humayun Abdulali, Honorary Secretaries, Bombay Natural History Society, for making arrangements for the tour and further for the encouragement they gave us in the field by visiting us while collecting at 'Robbers' Cave'. To Mr. V. K. Chari and Mr. C. J. Daniel of the Bombay Natural History Society, I am grateful for their companionship and constant aid in the field.

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EXPLANATION OF PLATE

Puntius sahyadriensis, sp. nov.

1. Lateral view of male specimen at the time of breeding ×$2\frac{1}{8}$.

2. Ventral view of same ×$2\frac{1}{8}$.

3. Lateral view of head and anterior part of the body of female specimen ×$2\frac{1}{8}$.

4. Ventral view of same ×$2\frac{1}{8}$.

5. Outer ray of the pectoral fin of male specimen during breeding season showing the spine-like tubercles ×8.

6. Outer ray of the pelvic fin of male specimen during breeding season showing the spine-like tubercles ×8.

SOME BREEDING BIRDS OF SINGAPORE

BY

W. T. LOKE

PART I

(*With five plates*)

In a recent article on the photographing of the Whitebellied Sea-eagle (*Haliaëtus leucogaster*), I wrote of it as if it were a Singapore bird. In fact it is a bird of extremely wide range which extends from the 'coasts of India, Ceylon and Burma, from about the latitude of Bombay to the Malay Peninsula and through the Malay Archipelago to Australia, Tasmania and Western Polynesia'.[1] The photographs which illustrated my article were taken in South Johore, one of the states of the Federation of Malaya, and separated from Singapore by the narrow waters of the Straits of Johore. The illustrations for the present paper, were, however, all taken on the island of Singapore itself, and form a pictorial record of some of the more attractive citizens of a beautiful island.

The total area of Singapore is a mere 220 square miles. The human inhabitants number just over a million, and are composed of a number of different races. The bird population has never been estimated, but Gibson-Hill's 'Checklist of Singapore Birds' enumerates 280 species, of which 151 are 'almost certainly resident'. There are curious gaps in the list which would surprise a visitor from India. In the harbour there are no gulls, and indeed very few sea birds, so that the offal and fishing rights are the exclusive province of a few terns, the Brahminy kites and the sea-eagles. The reservoirs and the larger ponds do not have their calm surfaces ruffled by the presence of any water birds, and except for an occasional whistling teal or cotton teal, no ducks, by their arrival and departure, mark the coming of winter or of spring. The Common Sandpiper, almost alone, with a characteristic movement, bobs in the 'autumn' and bobs out the 'winter'. There are other gaps besides these, but it is not my purpose to dwell upon them.

The field ornithologist—and, of course, no bird photographer is ever a bird photographer pure and simple—will notice with interest that for the 151 resident birds, breeding records exist for a mere fifty or so. Rarity, in Singapore bird records, is not necessarily a measure of scarcity, but more often of neglect. Singapore is thus a splendid hunting ground for the field worker who, if he seeks will find, and if patient will be generously rewarded. A number of the photographs that follow represent first nest-records for which I claim no greater credit than that I had sometimes leisure enough to seek, or was fortunate enough to have generous friends, like Geoffrey Allen, give them to me. Let my pictures, therefore, now speak for themselves.

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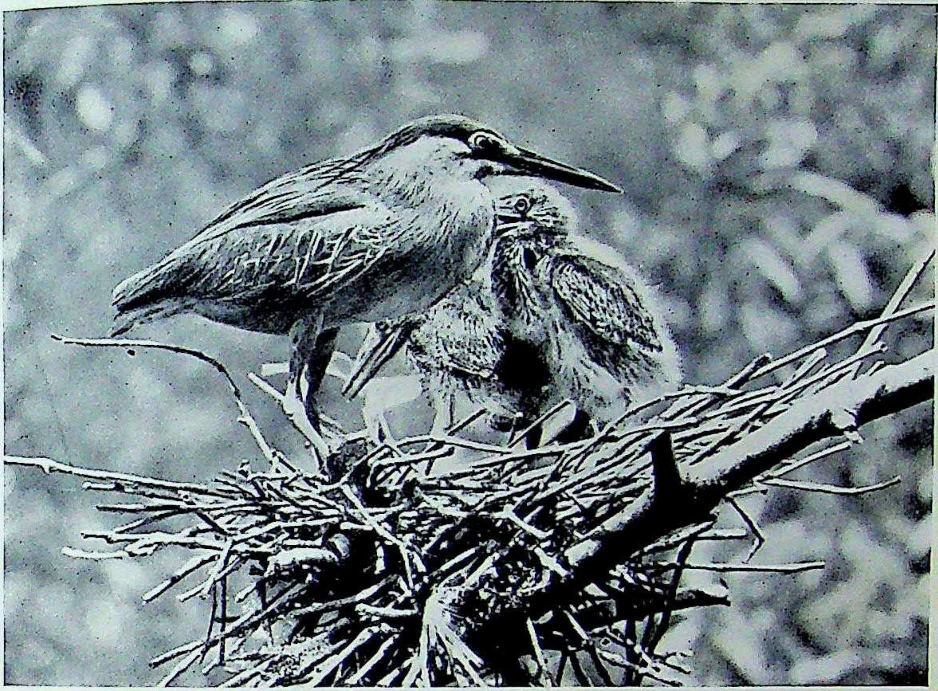
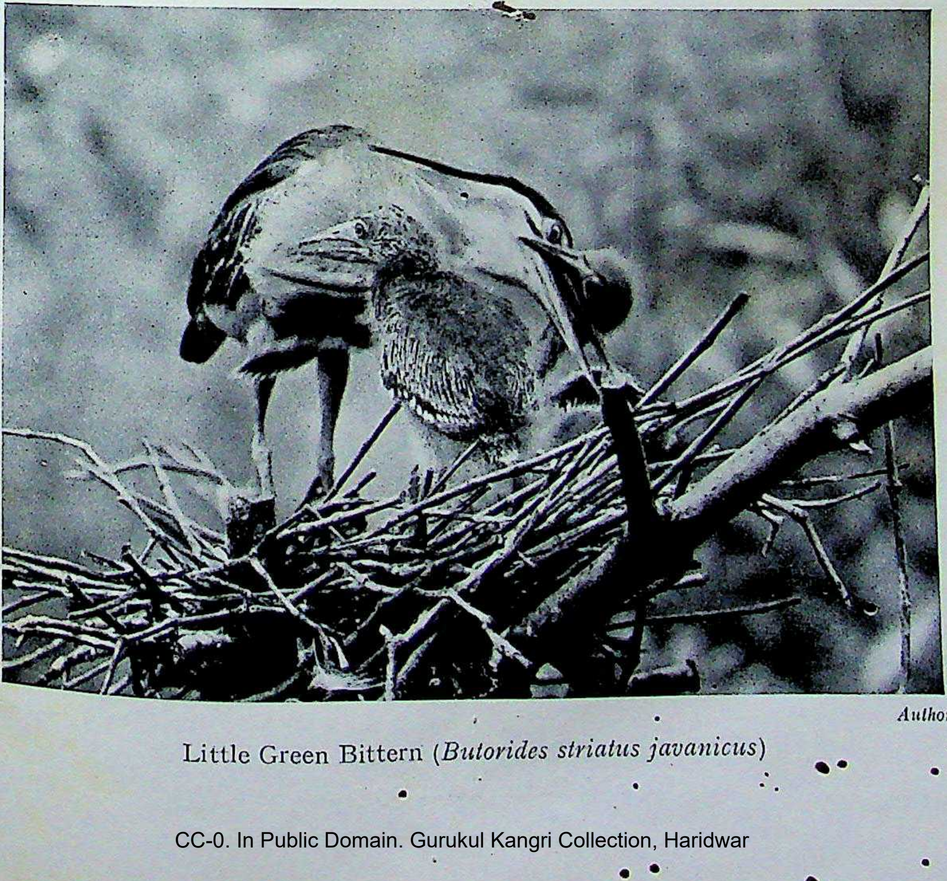
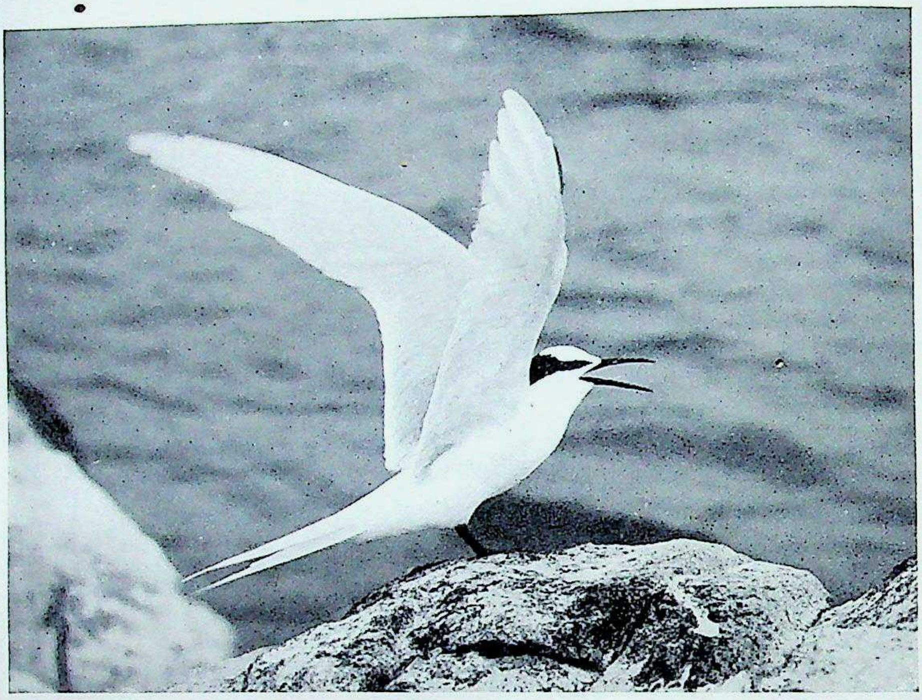
[1] Fauna of British India, Birds, 2nd ed., vol. V, p. 111.

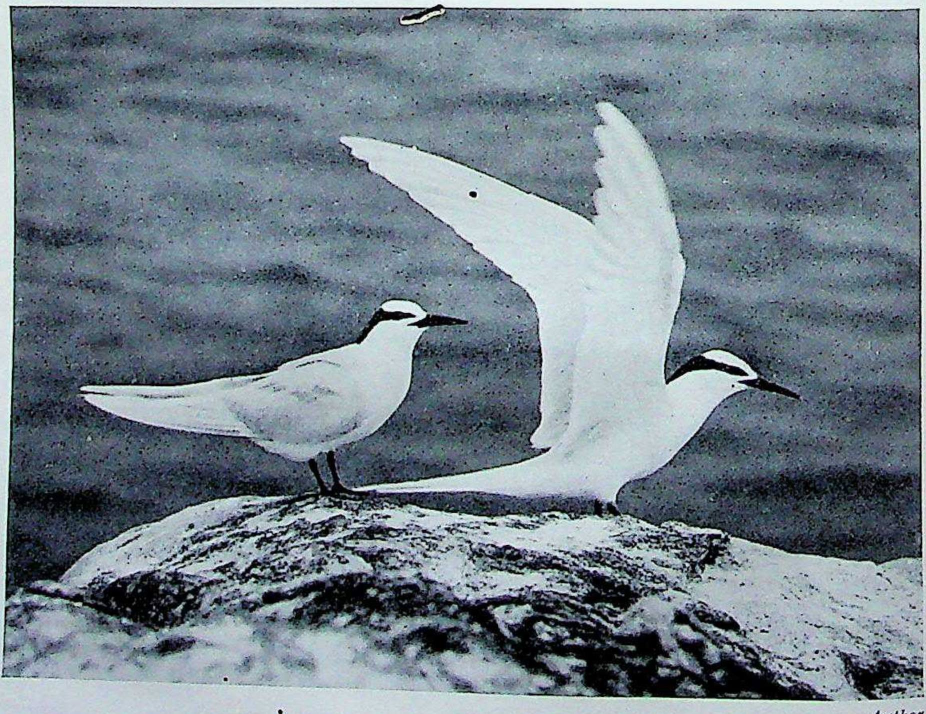




Author

Little Green Bittern (*Butorides striatus javanicus*)





Author

Blacknaped Tern (*Sterna s. sumatrana*)
Note bird's tongue in top photo

Little Green Heron. *Butorides striatus javanicus* (Horsf.).

This secretive little heron, although not uncommon about the coastal fringes and mangroves of Singapore, hides its light under a bush, if not a bushel. Known to be resident—young birds had been seen on several occasions—actual nests were not found until 1952, when they were discovered in two separate mangrove swamps on the island. The birds are solitary little fellows to be seen, quiescent and lonely, waiting patiently to pick up a meal beside a pool in the swamp, or at the edge of the mud when the tide is out. Kelham, one of the early naturalists, reported seeing in the Johore Straits 'hundreds of small green herons (*Butorides javanicus*)' which when approached 'rose in regular flocks', but this record seems to belong to the good old days when everything was plentiful. Nowadays, Butorides the Striated, answers more to Stuart Baker's description of it as 'a very solitary little bird'.

Even in the breeding season, it prefers a roomy nursery to a crowded maternity ward. I found three nests on the morning of June 24th, more by accident than design, when I was taking a walk in the mud in a mangrove swamp near Loyang, on the north shore of Singapore island. All the nests were placed about twelve to fifteen feet high, in mangrove trees: the first nest was still a-building; the second contained two pale green eggs with shells of a rough texture; and the third was occupied by a single bird in the clambering stage of youth. None of the nest trees grew very close together.

I marked down nest number two for photography, but my good intentions were elbowed out by business problems so that it was not until August 2nd that I was able to rendezvous at nest number one, which by now contained two young birds in an advanced stage of growth.

The juvenile birds, in down and quills, had the comical hunched look of tiny old men, the grey down on their heads lending them a reverence beyond their years. Their boundless energy and inquisitiveness belied these looks, and the vigour with which the adult's bill was seized and the 'oliver-twist', or asking-for-more-wrench, administered, was certainly a lesson in how to take liberties with one's parent. As is usual with birds of the heron tribe, the young were fed by regurgitation. When alarmed, the nestlings also operated their dumb waiter and brought up their food, which they swallowed again later when left in peace. If I came too close to the nest, however, they lunged out furiously with their sharp bills, a form of attack not to be taken too lightly.

Feeding occurred only at long intervals. After each meal, one adult, the female, always hopped on a nearby branch and spent many minutes scratching and meticulously preening her feathers. The male, unable fully to reconcile himself to the machan and the hide, approached the nest with caution, quickly delivered the groceries, and then beat a hasty retreat. The young, too, spent much of their spare time preening and scratching, in the process loosening feathers, which drifted away in the wind. One little fellow tried to stand on one leg while he scratched his head with the other, but he lost his balance and fell over. Anything moving about in the sky, especially aeroplanes, was watched intently.

After my first visit, there was to be an interval of a week before I could go to the nest again. By this time the young were so large that their home, flimsily built of sticks thrown roughly together, was too small to hold both birds at once. The larger bird of the two—the difference in size was very noticeable—kept peering over the edge of the nest, flexing his legs and seemed ready to jump. In the end, he did jump, and soon clambered out of sight of my lens. Not long after, a thunderstorm which had been brewing all morning suddenly broke and the rain came down in torrents. Wet to the skin, I, like the male heron, beat a hasty retreat, nor did I ever go back to the nest again because it was clear that the other youngster was also ready to leave the nest, and would have done so before my next visit.

Barred Bustard-Quail. *Turnix suscitator atrogularis* (Eyton).

The Bustard-Quail is a lover of grassland wherein it moves 'softly with no visible feet', and hides its little, round body so effectively that it is rarely noticed. Although, like all good birds it is heard and not seen, the Bustard-Quail is probably not quite so uncommon as might at first appear. There is a note in my diary which records with some surprise my discovery, in 1946, of one of these birds 'within sight of the workers' flats at Tiong Bahru', in a built-up area of Singapore.

Eha (E. H. Aitken) wrote in the 'Common Birds of India', 'one of the eccentricities of the Bustard-Quail is that the female makes all the noise. The male, as far as I know, is silent. He is smaller than she, and though I cannot say whether he is literally henpecked, there can be little doubt that he is "sair hauden doun". He has to stay at home and mind the babies while she goes gadding about and fighting with her female neighbours. This is not scandal, but a fact.'

It is indeed an odd fact that *Turnix atrogularis* is, by a reversal of the ordinary laws of nature, polyandrous. Among Indian and Malayan birds, it shares this peculiar distinction only with the Painted Snipe (*Rostratula bengalensis*). The female which is the larger bird, and very pugnacious, fights for the hand of her gentleman love, winning it in the public lists. Her inability to live at peace with her fellow women gets her into trouble because the wily Malay trapper, playing upon this weakness sometimes uses another hen as a decoy, and so succeeds in catching her.

The henpecked male, so timid in the sight of his Amazonian spouse, is nevertheless a veritable tiger in the defence of his family. Smythies, in his 'Birds of Burma', says that 'After hatching the eggs, which takes about 12 days, the male looks after the young and brings them up, performing his duties in an admirable manner; he feeds and tends them with the greatest solicitude, brooding them at night and fighting for them against all possible enemies, sometimes including their own mother, with the greatest bravery.'

My photographs were taken at the edge of a newly re-planted rubber estate, which borders one of the fairways of the Island Golf Club. The nest was a hollow in the ground, and contained four large eggs. I spent several afternoons in my hide, and when not concentrating on the bird, used to amuse myself watching the familiar figures of familiar friends, sometimes using familiar language, as they hit off their balls from the raised platform of the old fourth tee.

Blacknaped Tern. *Sterna s. sumatrana* Raffles.

This pretty little sea tern clearly finds the territorial waters of Singapore not absolutely to its liking. Although counted among the resident birds, its numbers have always been so small that the first nests were found only in 1949. In winter, there is usually an influx of visitors which slightly augments the local population. Outside the Malay Peninsula (an area in which it is nowhere very plentiful), the range of this bird is said to be, 'Tropical Indian and Pacific Oceans. Breeds on coral islands from Madagascar and the Seychelle Islands to the Malay Archipelago and northern Australia, southern China, the Philippine Islands, Liu Kiu Islands, and Samoan Islands.'[1]

The Blacknaped Tern exhibits a particular fondness for small islands, or even large rocks, whereon to place its nest. My photographs were taken on a large rock, lying in mid-stream in the Straits of Johore, just off the seaside resort of Loyang. Two pairs of breeding birds were using the site, and we discovered one young, almost ready to fly, and one egg. The usual clutch is said to be two, but it seems unlikely that the Malay fishermen had raided this small colony, although F. G. H. Allen when he first discovered it on June 12th, 1949, reported finding three breeding pairs, two with clutches of 2 eggs, and one with a clutch of 3.

I spent a whole day, on June 26th, 1952, photographing the birds. The tide was well out when we arrived at the rock at 8.30 a.m., and I had some difficulty in climbing it. Once on top, the high wind prevented me from erecting the cloth hide, and it is doubtful whether, even on a calm day, the tent could have been held erect on the bare surface. Eventually, the problem was solved by using what since that day has come to be known as a 'purdah' hide. I first set up the camera on its tripod, then draped the cloth of the hide over it, at the same time anchoring down the ends of the tent firmly with a few bricks. While my friends who had brought me out in the boat went off fishing, I crawled into this upright sack, taking care not to raise my head too high. Fortunately it was a relatively cool day without too much direct sun, otherwise the top of my head, protected merely by a single thickness of khaki cloth, might have come to the boil long before the job was finished.

At first the birds were suspicious, as was to be expected. At long last after three hours of patient waiting, they returned, and thereafter showed very little more fear of the hide which, being well held down, never flapped in the wind. During the entire period of waiting, the young bird which I was watching kept perfectly immobile, never so much as batting an eyelid.

The adult birds differed in size, as well as in colour: one was slightly larger than the other, and had pale grey wings; the smaller bird was almost pure white. Even with the sun behind clouds, they looked startlingly bright against the dark grey sea. When they flew around, they uttered impatient grating cries, and always called when they landed on the rock. The illustration at page 591 distinctly shows the tongue of the bird as it makes its landing cry.

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[1] W. B. Alexander, 'Birds of the Ocean', p. 194.

I finished my photography at three o'clock in the afternoon. By this time, after sitting doubled up for 6½ hours in the hide, I felt and probably looked, exactly like a boiled prawn.

Lesser Crow-Pheasant, *Centropus bengalensis javanensis* (Dumont).

Cuckoos, as a family, generally live up to an evil reputation. In Europe, now, as in Shakespeare's time,

When daisies pied and violets blue
  And lady-smocks all silver-white
And cuckoo-buds of yellow hue
  Do paint the meadows with delight,
The cuckoo then, on every tree,
  Mocks married men; for thus sings he, Cuckoo;
Cuckoo, cuckoo; O, word of fear,
  Unpleasing to a married ear!

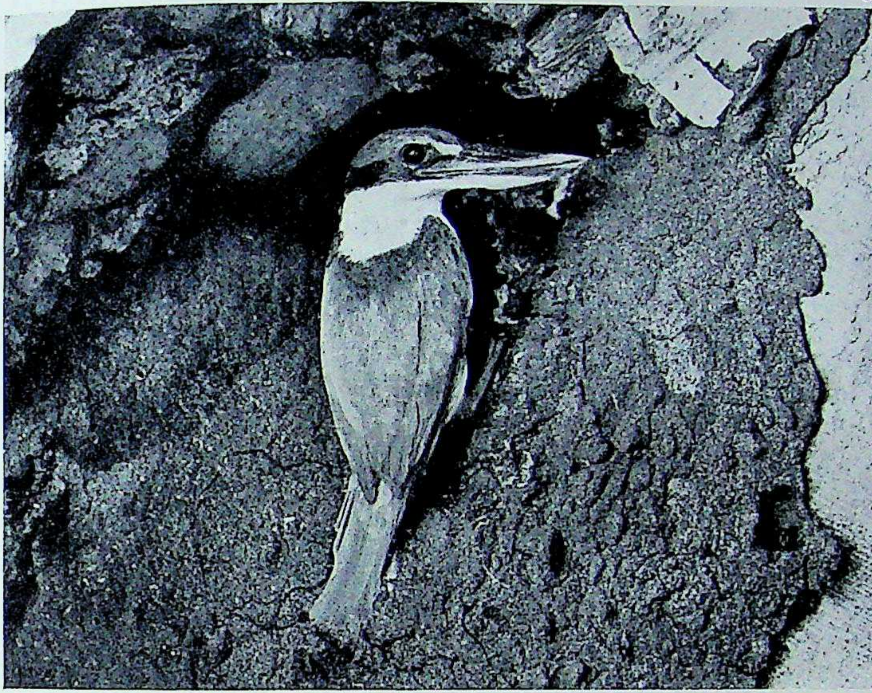
And unpleasing, not only to human ear, but also to the ear of birds. In Europe, or India, or Malaya, or wherever the parasitic cuckoo is to be found, its presence is not welcomed by the avian population which frequently mobs it. Even in a family of black sheep, there must be a few white ones; one of the white ones, in an otherwise predominantly black family, is *Centropus bengalensis*, known also as the Lesser Crow-Pheasant, Coucal or Lark-heeled Cuckoo. This member is thoroughly respectable, building its own home and rearing its own family. And, I regret to say, like many nice, respectable people, it is also rather dull.

Its body and tail are black, and wings dark chestnut. The bill is black, as also are its legs and feet. Whereas the adult bird looks dull and behaves in an equally dull manner, the young is positively ugly. In the down and quill stage, black skin covers its whole body, and stiff white hairs sprout from the top of its head. When I put my hand on the nest, it hissed violently at me like a snake, causing a sudden and quite unpremeditated withdrawal.

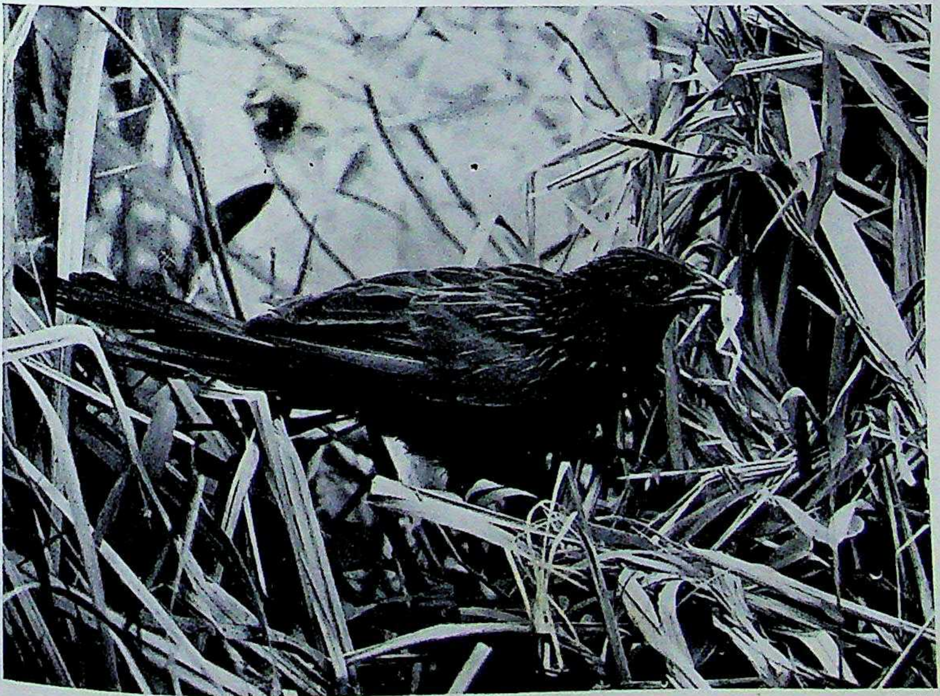
The adult bird, with its rounded wings, is not a strong flier but progresses by means of several quick wing-beats, followed by a glide. The usual call is a loud *hood-hood-hood*, which it utters from the top of some low bush or patch of thick lalang-grass. When the parent bird approached the nest, it called a rapid *chick-chick-chick-chick-chick*, followed by a slower *kwok*, *kwok*, *kwok*, *kwok*.

The nest at which my photographs were taken was found in heavy lalang, in wet ground near a small stream. It was a domed structure, made by pulling down the tops of the grasses and weaving them into the nest. The inside was lined with green leaves of the cashew-nut tree, and was far from clean. It was through noticing a bird with a green leaf in its beak which first led me to the nest.

For a bird of its size, it was surprising how often the young was fed. The food consisted of grasshoppers, several praying mantis, a number of small frogs and one small lizard. The parent bird always



Whitecollared Kingfisher (*Halcyon chloris humii*), Singapore.
The bird is nesting inside a live nest of termites



Author

Lesser Crow-Pheasant (*Centropus bengalensis javanicus*)

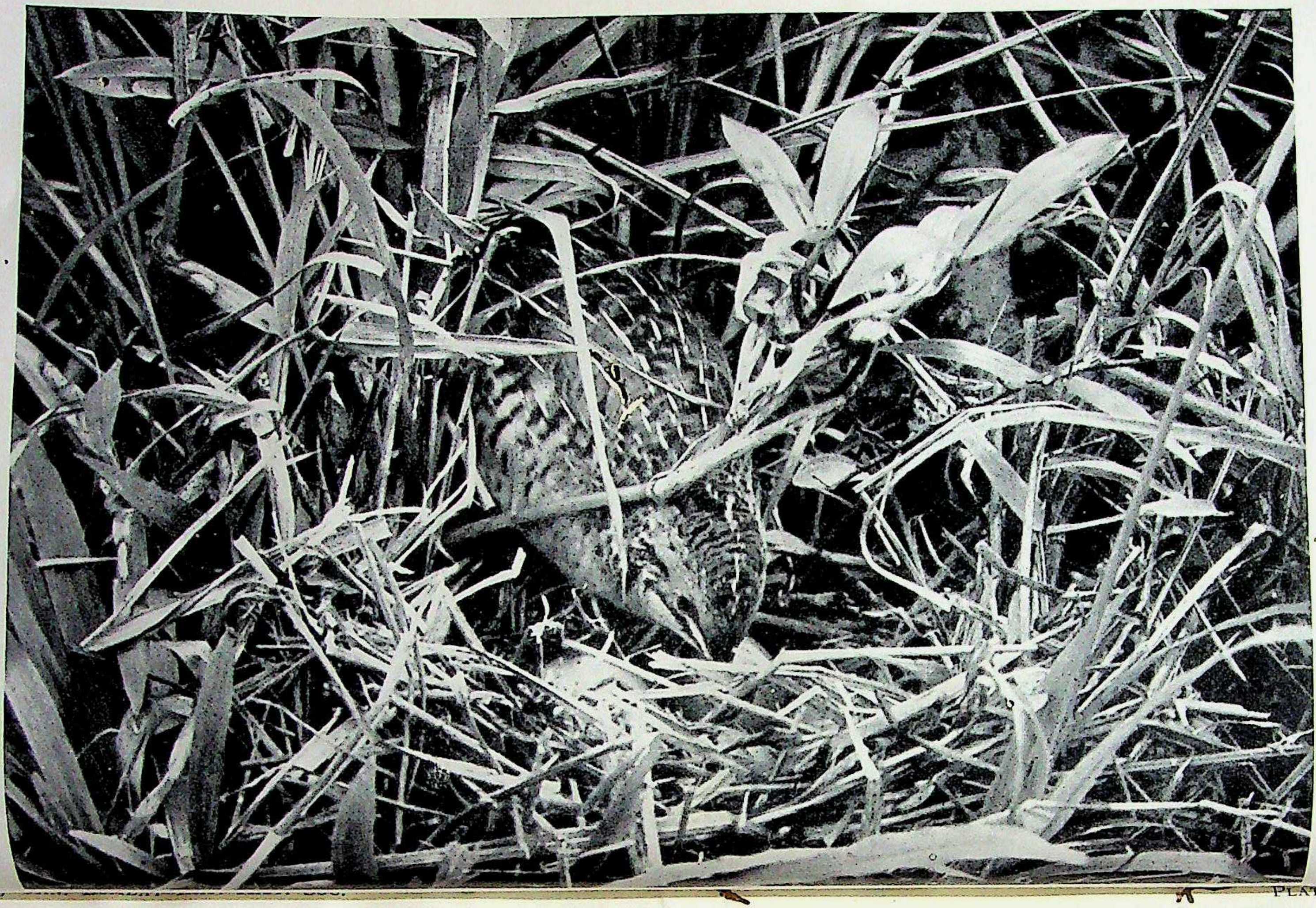
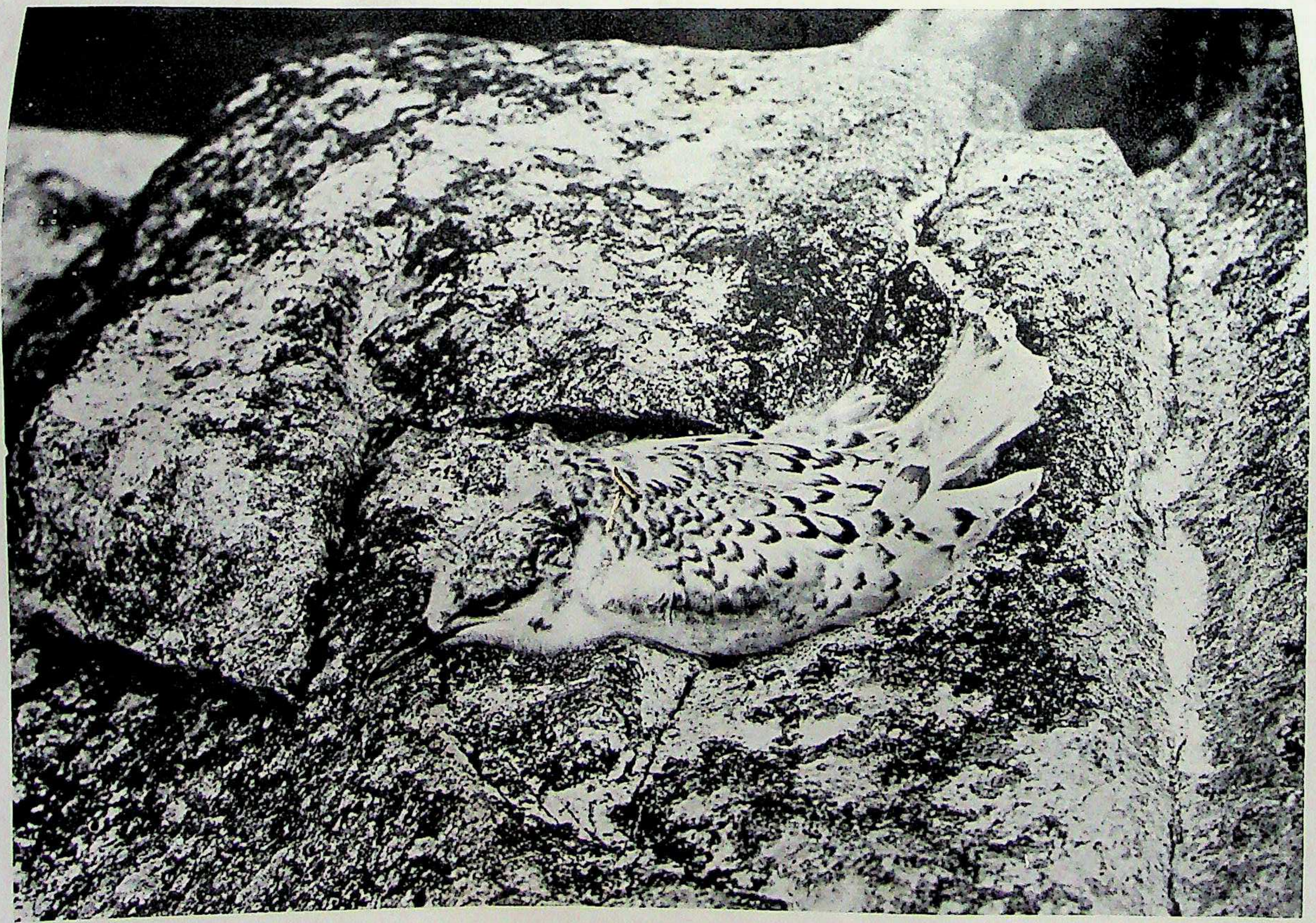


PLATE V



Author

Young chick of Blacknaped Tern (*Sterna s. sumatrana*), Squance Rock, Loyang, Singapore. Note protective coloration.

flew into a heavy patch of lalang just behind the nest, then approached it with a curious, side-stepping, ambling gait. After feeding, it would make a leisurely stay, sometimes waiting for the young to present its 'registered package', and then away it would go with flopping flight and long legs trailing behind.

The single young in this nest came to a sad end. On my second visit, more than a week after the first, the little bird had grown so much that when I put my hand on the nest to push back a few loose grasses, it hopped out and jumped into the lalang. My assistant, Ah Luan, rushed round to try and catch it, but in doing so stepped on and squashed it to death. In death, as in life, it was not a pretty creature.

My fellow countrymen are said to esteem this bird for its medicinal properties when soaked in alcohol. Its black skin would certainly indicate to Chinese people its health-giving properties. Malays, too, put the bird to medicinal use.

Altogether, a black knight in shining armour!

Whitecollared Kingfisher. *Halcyon chloris humii* Sharpe.

This common bird of a Singapore garden discloses its presence by its loud, raucous laughter. It is particularly vocal in the early morning, greeting the new day with a harsh, but cheerful voice. The pure white body and collar, and green-blue wings, make it so conspicuous that it cannot fail to be noticed. Water is not essential to its well-being, and although most in evidence in the mangrove belt, or near the seashore, it also lives and breeds some miles from the sea. Nor does it depend solely upon sea-food for its diet, but thrives equally well on the insects of an inland garden. I have seen it feed its young with grasshoppers, mole-crickets and even a medium-sized centipede.

This kingfisher has a curious preference for ants' nests wherein to place its own. A termite's nest is found to be a highly desirable place for a nursery, and black ants' nests are also used. Stuart Baker, when told of this curious story of symbiosis by Kellow in 1913, could not quite believe it to be true; he placed aside the collection of eggs which the latter had sent to him 'until this strange story could be confirmed or contradicted'. The fact was soon confirmed, and Stuart Baker quotes in full a long account of the breeding habits of *Sauropatis chloris chloris*, by E. G. Herbert of Siam, of which I give below an interesting extract:—

'. . . Another situation was in a white-ant's hill, which was about 3 feet high. This white-ant's hill was close to a native house in a fruit-garden near Paklat, and the first time I visited the place was on 16-5-13. On this occasion the young had left the nest and were sitting on a tree close by. The owner of the house offered to show me the nest, and chipped a line around the side of the ant-hill at the level of the entrance-hole, so that the top could be lifted off complete. This he did, exposing to view the nest and entrance tunnel. He said that he had taken the top off in this way on several occasions and that the birds had not deserted. He also said that the birds nested there every year at about the same time. The following year I again visited the spot and the male opened the nest in the same way, showing me on this occasion three half-fledged birds. The parent birds were exceedingly noisy, but shortly after we had finished one of them entered the nest, so there was no fear of them deserting. The ants' nest was "alive", and the ants set to work at once to join the top with the main block.'

My photographs were taken in the Sime Road area of Singapore, near MacRitchie reservoir, but some distance from the sea. The kingfisher's nest was placed inside a termites' nest, situated in an *Albizzia falcata* tree some 15 feet from the ground. The ants' nest was alive, and the photograph clearly shows the way in which areas of bark have been stripped off the tree. Before I had an opportunity to examine the birds' nest, however, its contents were robbed by some young urchins.

One day, after a spell of photography I emerged from the hide at the top of the wooden tower, just as a Malay woman, of ripe years but youthful instincts, passed by beneath:

'Eh, ba!', said she in surprise 'what are you doing up there?'

'I am taking pictures of birds', I replied.

'Oh ho!', she said 'you can't fool me. That's as cleverly disguised a human love-nest as ever I've seen.' And laughing another sensual laugh, she continued on her way.

(*To be continued*)

HOST PLANTS, DISTRIBUTION AND ABUNDANCE OF THRIPS (*THYSANOPTERA*) OF BOMBAY STATE[1]

BY

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In the Bombay State, the natural order Thysanoptera has not been studied previously and from the survey of the scattered published and unpublished reports it had become abundantly clear that a large scope existed in studying the distribution and abundance of thrips fauna in this State. Further, in the past, though several persons have worked on the systematics of Thysanoptera in the Indian sub-continent, little information has been published as to the host range of the species so far described. Hence an attempt was made to survey the Bombay State with a view to collect and identify the species prevalent in this area, and record their hosts, the plant part ordinarily infested, the intensity of abundance and the period of the year when the insect can be found.

During 1950 and 1951 insects were collected from the following localities: Viramgam, Detroj, Pavaghadh, Baroda, Anand and Surat, in Gujarat; Bombay suburbs; Khandala, Lonavala, Poona and its surroundings in Deccan.

From a survey, lasting over two years, it is estimated that a total of nearly 70 species of the suborders Terebrantia and Tubulifera are in our collection. Out of these so far we have been able to positively identify 17 species of the suborder Terebrantia. The remaining are under study and the information pertaining to them will form the matter for a subsequent communication. The identified species are the following:—

Suborder Terebrantia Haliday

Family Aeolothripidae Uzel.

1. *Aeolothrips fasciatus* Linn.

Family Heliothripidae Shumsher.

Subfamily—Heliothripinae Karny.

2. *Hercothrips indicus* Bagnall.
3. *Rhipiphorothrips cruentatus* Hood.
4. *Tryphactothrips rutherfordi* Bagnall.

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[1] Being a part of the thesis for M.Sc. (Agriculture) Degree of Poona University, presented by the first named author under the guidance of the latter.

Family Thripidae Uzel.

Subfamily—Chirothripinae Karny.

5. *Chirothrips manicatus* Haliday.
6. *Neocrynothrips (Ramakrishnothrips) jonnaphila* Ramakrishna.

Subfamily—Thripinae Karny.

7. *Achaetothrips mundus* Karny.
8. *Anaphothrips flavicinctus* Karny.
9. *Anaphothrips (Dantabahuthrips) sacchari* Shumsher.
10. *Anaphothrips (Scirtothrips) dorsalis* Hood.
11. *Ayyaria chaetophora* Karny.
12. *Frankliniella sulphurea* Schmutz.
13. *Microcephalothrips brevipalpis* Karny.
14. *Scolothrips asura* Ramakrishna and Margabandhu.
15. *Scolothrips sexmaculatus* Pergande.
16. *Thrips (Isothrips) orientalis* Bagnall.
17. *Thrips tabaci* Lindeman.

While collecting these species, notes were made as to the locality, hosts, part of the plant infested and the abundance. This information along with the relevant information published by earlier workers is put together and given below.

Suborder TEREBRANTIA

Family Aeolothripidae

1. *Aeolothrips fasciatus* Linn. (1761)

The existing information pertaining to the hosts, parts of plants infested and the locality are tabulated below:—

Family of host plant	Host species	Plant part infested	Locality	Period of collection	Reference
Anacardiaceae	*Mangifera indica*	Flowers	Pusa	1910	Bagnall (1919)
Compositae ...	*Carthamus tinctorius*	,,	Delhi	1910	Hood (1919)
Cruciferae ...	*Brassica campestris* var. *dichotom*	,,	,,	—	Shumsher (1949)
	,, ,,	,,	,,		,,
	var. *sarson*	,,	,,		,,
Graminae ...	*Saccharum officinarum*	—	,,	1910	Ramk. & Marg. (1913)
Leguminosae	*Lathyrus odoratus*	Flowers	,,		Shumsher (1949)
	L. sativus	,,	,,	1910	,,
	Medicago sativa	Leaves	,,	1910	,,

Several examples of this species were collected at Poona in January 1951 on leaves and leaf sheaths of *S. officinarum* (Gramineae) and a few examples on flowers of *Allium cepa* (Liliaceae). The intensity of infestation was mild on the former host plant whereas it was insignificant on the latter.

Family Heliothripidae.

Subfamily—Heliothripinae.

2. *Hercothrips indicus* Bagnall (1913).

Information regarding the range of host plants, the plant part infested and the distribution recorded in India is given below:—

Family of host plant	Host species	Plant part infested	Locality	Period of collection	Reference
Araceae ...	*Colocasia* sp.	—	N. Circars	—	Ramk. (1928)
Cruciferae	*Brassica oleracea*	—	Bombay	—	,, ,,
Leguminosae	*Arachis hypogaea*	Flowers	S. Arcot	—	,, ,,
	Crotolaria juncea	—	Pusa	—	,, ,,
Palmaceae ...	Date palm	—	Sirguppa	—	,, ,,
Solanaceae...	*Solanum melongena*	—	Surat	—	,, ,,
	S. tuberosum	—	Bombay	—	,, ,,

This species has been found on the leaves of *Gynandropsis gynandra* (Capparidaceae) in a mild form at Anand in January 1950. Similar infestation has been also noticed on leaves and flowers of *Dianthus plumeri* (Caryophyllaceae) in the month of March 1951 at Poona while moderately heavy infestation on the leaves and stems of *Carthamus tinctorius* (Compositae) have been seen mildly infested in September and February 1950 at Poona. The flowers of *Antirrhinum* sp. (Scrophulariaceae) had mild infestation in January 1951 in the same localities.

In addition to brinjal and potato reported by Ramakrishna (1928) this species has been found to infest mildly the leaves of tomatoes (*Lycopersicon esculentum*, Solanaceae) in the month of October 1950 near Anand, while at Poona the species has been observed infesting potato crop in February 1951.

The other host plants of the species are *Foeniculum vulgare* (Umbelliferae) and *Cannabis sativa* (Moraceae). Mild infestation on the leaves and stems of the former has been observed at Anand in October 1950, while the infestation on leaves and stems of the latter was moderately heavy in December 1950 at Poona.

As the species causes considerable damage to cultivated plants, it is one of the agriculturally important species. It is however interesting to note that though this species is a serious pest on cotton in Sudan (Corbett 1920) the earlier (Ramk. 1932) and present observations for 1950 and 1951 in many localities have curiously shown that it was neither present on cotton nor on any plant of the family Malvaceae to which cotton belongs. But just recently in September-October 1952, we have recorded this insect as a pest on cotton and *F. vulgare*, causing severe damage at Viramgam, and in other N. Gujarat districts.

3. *Rhipiphorothrips cruentatus* Hood (1919).

This insect is also of considerable agricultural importance, as a large number of economic host plants have been found to be infested. Ramakrishna Ayyar (1928) has described the injury caused by this insect on grapes. The existing information as to its host, range, etc., is given below:—

Family of host plant	Host species	Plant part infested	Locality	Period of collection	Reference
Anacardiaceae ...	*Mangifera indica*	Leaves	Lyallpur	—	Ramk. & Marg. (1939)
	,, ,,	Flowers	Coimbatore	1924	Karny (1925)
Combretaceae ...	*Terminalia arjuna*	Leaves	Lyallpur	—	Ramk. & Marg. (1939)
Mimoseae ...	*Prosopis spicigera*	,,	Maddur	1928	Karny (1925)
	,, ,,	,,	Bangalore	—	Ramk. (1928)
	,, ,,	,,	Lyallpur	—	Ramk. & Marg. (1939)
Myrtaceae ...	*Eugenia* sp.	,,	Coimbatore	1924	Ramk. (1928)
Punicaceae ...	*Punica granatum*	,,	Lyallpur	—	Ramk. & Marg. (1939)
Rosaceae ...	*Rosa* sp.	,,	Coimbatore	—	Karny (1928)
	,,	,,	Palur	—	Karny (1928)
Vitaceae ...	*Vitis vinifera*	,,	Coimbatore	1923	Karny (1923)
	,, ,,	,,	Bezwada	—	Ramk. (1928)
	,, ,,	,,	Madura	—	Ramk. & Marg. (1931)
	,, ,,	,,	Travancore	—	Ramk. & Marg. (1931)

In addition to *T. arjuna* reported earlier (Ramk. and Marg, 1939), this species has been found to infest mildly the leaves of *T. catappa* in August 1951 at Anand.

In the family Myrtaceae and Punicaceae *Psidium gujava* and *Punica granatym* have also been found to be infested in the Poona region. The infestation of the former has been mild in September 1951 while the species is present in insignificant numbers on the leaves of the latter. The mild infestation on the leaves of *Rosa* sp. has again been observed in August 1950 the month in which the specimens were also collected in 1923 at Coimbatore (Karny 1925).

The species has greater economic importance as a pest on grape vine (*V. vinifera*). In the Bombay State it is particularly abundant in Nasik, whereas, moderate damage on the leaves has also been observed on this host in September 1951 in Poona.

4. *Tryphactothrips rutherfordi* Bagnall (1915).

So far this species has only been collected from the leaves of *Gossypium herbaceum* (Malvaceae) at Coimbatore (Ramk. 1928) and from the flowers of *Datura* sp. (Solanaceae) at S. Arcot (Pergande 1894).

From the collection made by us it is observed that the species has a wide host range. It has been found to infest mildly the leaves of *Calotropis* sp. (Asclepiadaceae) and *Acalypha* sp. (Euphorbiaceae) in the month of July 1950 at Poona. Mild infestation on the leaves of *Morus indica* (Moraceae) has been observed in September 1950 in the same locality. Further the leaves of *Santalum album* (Santalaceae) and *Sapindus trifoliatus* (Sapindaceae) have been observed to have few specimens of the species in January 1950 and October 1950 respectively at Baroda.

Family Thripidae.

Subfamily—Chirothripinae.

5. *Chirothrips manicatus* Haliday (1836).

The species has only been reported on *Nicotiana tabacum* from Coimbatore (Ramk. and Marg. 1931). In the Bombay State however few insects have been obtained from sweeping from grasses in April and August 1951 at Poona, and in December 1951 at Detroj.

6. *Neocorynothrips* (*Ramakrishnothrips*) *jonnaphila* Ramk. (1928).

The species has been observed on the flowers of *Brassica campestris* var. *sarson* (Cruciferae) at Delhi (Shumsher 1949). It is also common on the members of the family Graminae. It has been observed on leaves of *Saccharum officinarum* and in leaf sheaths of *Sorghum vulgare* (Ramk. 1928) at Coimbatore. It has also been collected from tassels of *Zea mays* at Guntur (Ramk. 1928).

Mild and moderate infestations of this thrips have been noted at Poona in the leaf sheath of *S. officinarum* and *S. vulgare* in August 1950 and April 1951 respectively.

Subfamily—Thripinae.

7. *Achaetothrips mundus* Karny (1925).

Formerly this species has been collected on wild host at Taliparamba (Karny 1925). However in Poona mild infestation on tender shoots and leaves of sweet potatoes (*Ipomoea batatas*, Fam. Convolvulaceae) has beeen observed in September 1950.

8. *Anaphothrips flavicinctus* Karny (1912).

Members of the family Graminae are most commonly infested by this species, however three other families of host plants also have been previously recorded. Detailed information pertaining to them is tabulated below:—

Family of host plant	Host species	Plant part infested	Locality	Period of collection	Reference
Gramineae ...	*Oryza sativa*	Leaf-sheath	N. India	—	Shumsher 1949
	Pennisetum spicatum	Leaves	,,	—	Shumsher 1949
	Saccharum officinarum	Leaf-sheath	,,	—	Shumsher 1949
	Sorghum vulgare	Leaves	S. India	—	Shumsher 1949
	,, ,,	Ear heads	Boilpatti	—	Ramk. 1928
	Triticum aestivum	Leaf-sheath	N. India	—	Shumsher 1949
	Zea mays	Cobs	,,	—	Shumsher 1949
Lythraceae ...	*Lawsonia inermis*	Flowers	,,	—	Shumsher 1949
Marantaceae..	Arrowroot	Leaves	Taliparamba	—	Ramk. 1928
Solanaceae ...	*Nicotiana tabacum*	Flowers	N. India	—	Shumsher 1949

Some of the members of the family Gramineae reported above have also been observed by us to be infested by this species. Thus, moderate infestations in the leaf sheath of *P. spicatum* have been noted in September 1950 at Viramgam and Detroj; and mild to heavy infestation on leaves and leaf sheaths of *S. vulgare* at Poona, Nasik, Anand, Baroda, Detroj and Borivali in the post-monsoon and early winter months of September, October and December 1950. The species was also present in moderate to heavy proportions on all aerial parts of *T. aestivum* in Poona, Bombay and N. Gujarat in the winter months of 1950 and 1951. The life history of this species has been worked out and is to be published separately. Few specimens have also been collected from the leaves of *Zea mays* in September 1950. It is also common on other grasses throughout the year in Poona and N. Gujarat.

In addition to the graminaceous hosts mentioned above mild infestation on the leaves of *Avena sativa* and *Echinochloa stagnina* have been observed in September 1950 at Poona. It has also been seen in mild abundance in the leaf sheaths of *Cynodon dactylon* in February 1951. The other host observed is *Eleusine coracana,* the leaves of which have shown mild abundance in September and October 1950 at Poona and Anand respectively.

As in N. India (Shumsher 1949) this thrips has been also observed on the flowers of *N. tabacum* in September 1950 at Poona, while few insects have also been collected from the leaves of *Lycopersicon esculentum* (Solanaceae) at the same place and time.

Apart from the families mentioned above a few examples of this species have been collected from the leaf sheaths of *Canna indica* (Cannaceae) and flowers of *Lagasca mollis* (Lobeliaceae) in September 1950 at Poona.

9. *Anaphothrips* (*Dantabahuthrips*) *sacchari* Shumsher (1949).

The species was described from specimens on the leaf sheaths of sugarcane (*S. officinarum*, Fam. Gramineae) at Rupar, N. India (Shumsher 1949). At Poona insignificant population has been observed on leaves of grasses, *P. spicatum* and the leaf sheath of maize (*Zea mays*) in post-monsoon months of 1950 and 1951. It has also been collected from leaf-sheaths of grasses from Baroda in October 1951.

10. *Anaphothrips* (*Scirtothrips*) *dorsalis* Hood (1919).

In India, this is probably the most important economic species of the order Thysanoptera. As a pest on chillies (*Capsicum annuum*) it is known to cause the leaf curl locally known as '*Murda*' disease. Its life history has been worked by Ramchandra Rao in the year 1928. In the Bombay State it is not only a serious pest on chillies but also on the newly evolved long staple varieties of cotton. The bionomics and control of this species which is under study will be published separately.

The species has been recorded in Coimbatore on shoots of *Ricinus communis* (Euphorbiaceae) on the flowers of *Poinciana pulcherrima* (Leguminosae) on *G. herbaceum* (Malvaceae), on flowers of *P. granatum* (Punicaceae) and on *Solanum melongena* (Solanaceae) Ramk. (1928).

According to our observations this thrips has got a much wider range of host plants and can be called a truly polyphagous species. In addition to the five families of host plants mentioned above it has now been collected from twelve more families.

Mild infestation has been seen on the flowers of *M. indica* (Anacardiaceae) and *C. indica* (Cannaceae) in October 1950 at Anand and Baroda respectively. The flowers of *Echinops echinatus* and *Gerbera* of the family Compositae have been found to have insignificant population in January 1950 and August 1951 respectively at Poona. In the post-monsoon months of September and October of the same year, mild infestation of the species has been observed on the flowers and leaves of *Raphanus sativus* (Crucifereae) at Anand and Poona. At the latter place a few specimens have also been collected from the leaves of *Dioscoria argeria* (Dioscoriaceae) in the same season. As reported by earlier observers (Ram. 1928) the species has been collected on *R. communis*, from Anand and Detroj from Gujarat; mild infestation was found on its flowers and leaves in December 1951. The leaves of *Setaria indica* (Gramineae) have also been found to have insignificant population in November 1950 at Poona.

In the family Leguminosae mild abundance on the flowers of *Acacia arabica*, insignificant population on the leaves of *Dolichos biflorus* and on the shoots of *Phaseolus mungo* have been noted in September 1950 at Poona. Among the different species of cotton, *G. hirsutum* has shown mild to heavy incidence on all aerial parts from August to October at Poona, Jalgaon and Surat, while the infestation was mild on *G. herbaceum* in September 1950 at Poona and in December 1951 at Anand. In the same season of 1950 the species has been mildly abundant on flowers of *Prosopsis spicigera* (Mimosae), while a few specimens were also collected on flowers of *Psidium gujava* (Myrtaceae) and buckwheat at Poona. At the same place and in nearly the same season mild infestation has been noted on leaves and tender parts of *Rosa* sp. (Rosaceae). The leaves of *Mimusops hexandra* (Sapotaceae) and *Zingiber officinale* (Zingiberaceae) have been observed to have few specimens in September and October of 1950, at Anand and Poona respectively.

In the family Solanaceae mild infestation on the flowers of *Datura metel* in July and insignificant population on the leaves of *L. esculentum* in September 1950 have existed at Poona.

11. *Ayyaria chaetophora* Karny (1926).

The species has been previously recorded on *R. communis* and garden croton (Euphorbiaceae) at Samolkot and Coimbatore (Ramk. and Marg. 1931). In Bombay State an additional host *Acalypha* sp. of the same family has been noted with mild infestation on its leaves in July 1950 at Poona. Negligible infestation on an unidentified host species locally known as *Dudhakado* was found at Pavaghadh (Gujarat) in October 1950.

The flowers of *Vigna catjang* (Leguminosae) have been mentioned as the host from Talimparamba in September 1908 (Karny 1925). The other known host of this family is *Canavalia ensiformis* from which insects were collected in 1933 by Javeri at Poona, the slide of which is in our collection.

The only other family of host plant noted is that of Amaryllidaceae a few examples on the flowers on *Hymenocallis* sp. have been collected in July 1950 from Poona.

12. *Frankliniella sulphurea* Schmutz (1913).

This insect has a wide range of host plants and is generally more abundant in flowers and causes less damage to leaves. The host plants recorded so far are listed below:—

Family of host plants	Host species	Plant part infested	Locality	Period of collection	Reference
Convolvulaceae	*Convolvulus* sp.	Flowers	Lyallpur	—	Ramk. & Marg. 1939
Cucurbitaceae ...	*Benincasa cerifera*	Leaves	,,		,,
	Citrullus vulgaris	,,	,,		,,
	Cucurbita maxima	,,	,,		,,
	Luffa aegyptica	Flowers	,,		,,
	Momordica charantia	,,	,,		,,
Leguminosae ...	*Crotolaria juncea*	,,	,,		,,
Malvaceae...	*Hibiscus cannabinus*	,,	,,		,,
	,, *esculentus*	,,	,,		,,
Rosaceae ...	*Rosa* sp.	,,	,,		,,
Solanaceae	*Capsicum frutescens*	,,	,,		Ramk. 1939
	,,	,,	Kadiyan		Ramk. 1928

In addition to the six families of host plants stated above *F. sulphurea* has been found on fifteen other families. In October 1950 mild infestation has been observed in the flowers of *Celosia* *argentea* (Amaranthaceae) at Pavaghadh and some specimens were also collected from flowers of *Nerium indicum* and *Vinca rosea* of the family Apocynaceae at Viramgam. The flowers of *Dianthus plumeri* (Caryophylaceae) have been observed with mild intensity in April 1950 at Poona.

The flowers of five species of the family Compositae have also been observed as host plants, on all of which the infestation was of a mild nature. The collections from *Chrysanthemum* sp., *Helianthus annuus, tegetes erecta* were made in October 1950 at Pavaghadh, Anand and Viramgam respectively. At Poona mild infestation has been observed on *Dahalia* sp. in August 1950 and in 1951 on *Echinops echinatus*.

The flowers of *Ipomea* sp. (Convolvulaceae) have been observed to have mild infestation in November 1950 at Poona, while similar infestation was observed on the flowers of *Lagenaria siceraria* (Cucurbitaceae) in October 1950 at Pavaghadh. The flowers of *Trichosanthus alba* and *Momordica charantia* of the latter family have been observed to have mild and insignificant infestation in August and October 1950 at Poona and Anand respectively.

A few specimens of the species have also been collected from the flowers of *Geranium sanguineum* (Geraniaceae) and *Ocimum canum* (Labiateae) in October 1950 at Poona and Viramgam respectively.

In the family Leguminosae so far the insects have been observed on flowers of *C. juncea* (Ram. and Marg. 1939). The flowers of four more plants of this family have now been recorded as hosts. These are *Delonix regia* in October 1950 at Viramgam, *Dolichos lablab* in August 1951 at Poona, *Lathyrus sativus* in November 1950 at Poona and *Medicago sativa* in July 1951 at Mahableshwar. On all these except *M. sativa* the infestations have been of a mild nature while from *L. sativus* only a few specimens were collected.

Lagasca mollis and *Lobelia nicotinifolia* (Lobeliaceae) also have shown the presence of a few examples in October 1950 and March 1951 at Poona and Mahableshwar respectively. In addition to the two species of *Hibiscus* mentioned earlier (Ramk. and Marg. 1939), the flowers of *Hibiscus rosasinensis* have been observed with mild infestation in the month of October 1950 at Viramgam. A few individuals were noted on flowers of *H. esculentus* at Poona in July 1950. Further, scanty abundance of this thrips has been observed on flowers of *Sesamum indicum* (Fam. Pedaliaceae) in September 1950 at Poona and *Plumbago zeylanica* (Plumbaginceae) in October 1950 at Pavaghadh.

Moderate infestation on the flowers have been observed on *Portulaca* sp. (Portulacaceae, July 1951); *Zizyphus rugosa* (Rhamnaceae) September 1950; *Citrus grandis* (Rutaceae) December 1950; *Acras sapota* (Sapotaceae) July 1950 and on *Antirrhinum* sp. (Scrophulariaceae) July 1950, all of them at Poona.

As reported earlier (Ram. 1928 and Ramk. & Marg, 1939) *C. frutescens* has also been observed as host in October 1950 at Anand, the flowers of which were infested with a few of these thrips. In addition to the said plant of the family Solanaceae the flowers of *L. esculentum* and *S. melongena* have also shown similar infestation in August 1950 at Poona. The only other family noted is Verbenaceae, the younger leaves of *Clerodendrum phlomoides* of which have been seen with mild infestation in December 1950 at Poona.

13. *Microcephalothrips brevipalpis* Karny (1926).

This insect was originally described from specimens collected on flowers of *Chrysanthemum* (Compositae) August 1913, Coimbatore Karny (1925). It has also been collected from Coonoor on the same host (Ramk. 1928).

In addition to *Chrysanthemum* mentioned above the species has been now collected from the flowers of *Cosmos* sp., *T. erecta* and *Zinnia* sp. of the same family. The observed infestation at Poona on *Cosmos* sp. has been very little, while those on the second host moderately heavy and on *Zinnia* sp. in mild abundance. The collections from these hosts were made in September, August and July 1950 respectively.

The five other families from which this insect has been collected are Amaryllidaceae, Caryophylliaceae, Leguminosae, Lobeliaceae and Solanaceae. The host plants among these families are: *Hymonocallis* sp., *Danithus chinensis*, *Cyamopsis psoralioides*, *L. mollis* and *H. esculentum* respectively. A few specimens were collected from the flowers of the first four plants while in the case of *H. esculentum* the leaves were found to be slightly infested. The collections from these hosts were made from July to September 1950 at Poona.

14. *Scolothrips asura* Ram. and Marg. (1931).

Original record of this species was from leaves of Banana (*Musa paradisiaca*, Fam. Scitaminaceae) at Coimbatore (Ram. and Marg. 1931).

At Poona this species has come to our notice on the leaves of *Santalum album* (Santalaceae) in January 1951. The male of this species which has hitherto not been observed, has been collected by us the description of which will be published later.

15. *Scolothrips sexmaculatus* Pergande (1894).

This species is known to be a predator on mites on Cholam shoots (Ramk. 1928). Besides this, from Coimbatore, the species has been collected from the leaf sheaths of *S. vulgare* (Gramineae) (Pergande 1894) and the flowers of *P. granatum* (Punicaceae) (Karny 1925).

We have observed this insect as a predator on mites on chillies, *Colocasia* sp. (Araceae) and cotton. Mild population was found on the former plant in February 1952 at Poona. A few specimens also were collected from *Capsicum frutescens* (Solanaceae) and cotton in April 1951 from Poona.

16. *Thrips* (*Isothrips*) *orientalis* Bagnall (1915).

In India the species has been known from Coimbatore on flowers of *Jasminum* sp. in September 1913 and *Morinda tinctorum* Fam. Oleaceae, April 1919 (Karny 1925).

We have also observed this species in small numbers on flowers of *Jasminum* sp. in September 1950 at Poona.

17. *Thrips tabaci* Lindmen (1888).

This species is of world wide occurrence; in India the host plants recorded are *A. cepa* (Liliaceae) at Bellary (Ramk. 1928), *G. herbaceum* (Malvaceae) at Coimbatore (Karny 1925), Tea from Ooty (Ramk. and Marg. 1939) and *B. oleracea* (Cruciferae) at Bombay (Karny 1925). On the first host, namely onion, the insects are found on leaf sheaths while on cotton they have been collected on flowers and shoots.

In the Bombay State as in other places the species is a pest on onion and moderately heavy infestation has been observed in September 1950 at Poona, Anand, Detroj and Viramgam.

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ECOLOGICAL NOTES ON A COLONY OF SMALL SWALLOW-PLOVERS IN MYSORE STATE

BY

C. BROOKE WORTH

INTRODUCTION

In the *Journal* for December, 1951, pp. 405-406, a report was given of a colony of Small Swallow-Plovers, *Glareola lactea* Temmnick, that had been observed briefly in 1951 on a sand bar in the Hemavati River at Sakleshpur, Hassan District, Mysore State (1). During 1952 it was attempted to extend observations on these birds, and also to study the avifauna and history of the nesting site in relation to the swallow-plovers. Owing to only sporadic opportunities to visit the river, the following comments do not present as continuous a story as might be desired, but a seasonal trend of events can nevertheless be discerned.

As indicated in the original note about these birds, the Hemavati rose in response to the deluge of the southwest monsoon, and the island was inundated by 12th June, 1952. No swallow-plovers could be detected at that time nor for the remainder of the monsoon period, the sand bar also remaining concealed beneath the rushing surge of the river. When the rains abated in late August, sand bars reappeared in the previous vicinity, where the river made a rather abrupt bend, but it was at once obvious that the configuration of various islands was drastically altered. The main sand bar, which had been the former site of the colony, was now divided into a small upstream segment and a larger segment below, separated by a narrow but deep channel. The lower segment, moreover, reached closer to the western bank of the river, so that as the flood continued to subside, it became evident that the entire series of sand bars, including numerous narrow strips flanking the two main islands, would be more accessible from shore in 1952 than in 1951. Sand and gravel had been deposited by river currents in such a fashion that the upper island had the least elevation above low water, but a gradually rising slope toward the downstream tip of the lower island led finally to a terminal sand bank that must have been at least three feet higher than the least elevated portion of the upper island.

Table 1 indicates the dates on which the river was visited and records the birds noted on each occasion. Since some of the trips had to be very brief, complete observations of birdlife were not invariably made. However the swallow-plover census was meticulously taken in every instance.

The Little Green Heron, *Butorides striatus*, a species that was not noted in the survey of Mysore birds by Sálim Ali (2), has already been reported to that authority on the basis of a Bangalore sight record. The table contains two additional new species records for Mysore State, namely the Pied Harrier, *Circus melanoleucus*, and

Temminck's Stint, *Erolia temminckii*. Further comments on the species may be made as follows.

TABLE 1. Birds seen in 1951 and 1952
Hemavati River, Sakleshpur, Mysore State

	20 Nov.	22 Jan.	30 Jan.	7 Feb.	27 Feb.	13 Mar.	29 Mar.	14 April	28 April	12 May	29 May
Jungle Crow ...					1	2				1	
White Wagtail ...		1		1							
Large Pied Wagtail ...		1		2	+	1		2		1	
Malabar Crested Lark ...								2			
Pied Kingfisher ...	2				1		1			1	
Common Kingfisher ...		1		1	2					1	1
Brownheaded Storkbilled Kingfisher ...					1						
Whitebreasted Kingfisher ...					1						
Crested Serpent-Eagle ...					3						
Pariah Kite ...		1									
Pied Harrier ...					1						
Small Swallow-Plover ...		13	6+	13	20	18	21	12	4	6	12
River Tern ...		1									
Blackbellied Tern ...	2	2		2	3	2	1	2		2	2
Little Ring Plover ...	2	1		4	6	1	4	4	1	12	6
Redwattled Lapwing ...	12			6	2	2				2	
Green Sandpiper ...					2+			1			
Common Sandpiper ...	4	2		4	6	1	6	2			
Wood Sandpiper ...	10	2		6		2		2			
Greenshank ..	8	6		4	3	2	3	1		1	3
Temminck's Stint ...				1	3		2				
Whitenecked Stork ...				2							
Little Egret ...		3									
Little Green Heron ...			1								

1. **Jungle Crow,** *Corvus macrorhynchos* Wagler.

Undoubtedly crows are more frequent visitors to the island than indicated by the records in Table 1. The species was listed only when it occasioned special notice as when, on 13 March, I worried about the terns' chick, and on 12 May, when a pair of lapwings chased a Jungle Crow into a tree.

The apparent defencelessnes of swallow-plovers makes it difficult to understand why crows might not invade the colony at any time, drive them from their nests and consume the eggs or young. But even in the absence of such aggressive manoeuvres there were opportunities—probably daily—to rob the colony when human intruders disturbed the incubating birds. On my own visits I usually tried to make observations through binoculars at as great a distance as consistent with accurate visualization, but the record of footprints in the sand, plus occasional direct evidence, disclosed that local Indians frequently crossed the river at this point, using the island as a stepping stone. Often they drove cattle or buffaloes onto the island in order to wash them, and women also laundered clothes at the lower end of the large island. Remains of small fires were found in the vicinity, of the dhobies. Finally, some people merely wandered along the margins of the island looking for useful debris, or sometimes stranding tiny fish in shallow pools in order to scoop them up onto the sand to dry. But I was never able to detect that any of these intruders—human or animal—took a direct interest in nesting birds.

These many visitors, although arriving and departing sporadically, afforded multiple opportunities for crows and other predators to invade the nesting territory, for the circling parent birds were a conspicuous emblem of circumstances in the area. However I did not see any crow approach a nest; nor did I find eggs that had obviously been broken by marauders.

2. **White Wagtail,** *Motacilla alba* Linnaeus.

Although recorded by Sálim Ali as a 'fairly common' winter visitor in Mysore State, this wagtail was observed only irregularly by me in the Sakleshpur region. Its occurrence on the island is not significant.

3. **Large Pied Wagtail,** *Motacilla maderaspatensis* Gmelin.

This wagtail is undoubtedly to be considered as part of the island's fauna, for there was little question that the birds were breeding nearby and used the island as one of their foraging grounds. On April 14, a pair was seen in evident courtship. The presumed male lifted its wings over its back and ran back and forth in front of the other bird. The same or another male was observed later on the same day singing from the top of a small tree on the west bank of the river.

Relation to Swallow-Plovers: possibly the active pied wagtails serve to warn swallow-plovers of the approach of intruders. No evidence of competition between the species was obtained.

4. **Malabar Crested Lark,** *Galerida malabarica* (Scopoli).

A pair observed on the island on April 14 impressed me as behaving 'suspiciously', for they seemed reluctant to leave a certain small area of sand and gravel. Since, however, there is abundant suitable nesting terrain on a sparsely-grassed slope about a furlong beyond the west bank of the river, no reason why the island should have presented special attractiveness for this purpose was apparent. This is a frequently seen species in Sakleshpur in open habitats. Significance to Swallow-Plovers: probably nil.

5. **Pied Kingfisher**, *Ceryle rudis* (Linnaeus).

Sálim Ali (2) met this species uncommonly in Mysore State, but I have found it the second most abundant kingfisher in Hassan, Mandya and Mysore Districts, being exceeded in numbers only by the White-breasted Kingfisher. On repeated automobile journeys along the same roads, I have seen it time and again at the same locations, suggesting that it may be rather sedentary and patchily distributed. The ones at the Sakleshpur island probably nested in a sand-bank at the river's edge; several likely sites with holes in them were seen, and the birds' fishing activities marked them as residents.

No relationship between swallow-plovers and any species of kingfisher could be defined.

6. **Common Kingfisher,** *Alcedo atthis* (Linnaeus).

The remarks under the preceding species must not be construed as an indication that Common Kingfishers are uncommon at Sakleshpur, even though Sálim Ali found them generally so in Mysore State (2). On the contrary they could usually be seen on visits to the river, and I feel confident that they nested in one of its banks. On May 12, I saw a kingfisher catch one of the tiny fish that have already been mentioned as being collected by local Indians through a stranding device. Small as its prey was, the kingfisher first flew to a perch in order to knock the fish into insensibility before swallowing such a morsel.

7. **Brownheaded Storkbilled Kingfisher,** *Ramphalcyon capensis* (Linnaeus).

To the single record at the island on February 27, may be added two other closely contemporaneous records—of a pair—seen about fifteen miles downstream where the banks of the Hemavati are flanked by overhanging trees and fringing groves of bamboo. The species is probably resident but must be uncommon.

8. **Whitebreasted Kingfisher,** *Halcyon smyrnensis* (Linnaeus).

Whitebreasted Kingfishers were often seen and heard throughout the Sakleshpur area and elsewhere in neighbouring districts, despite Sálim Ali's statement that it is not a common species in Mysore State (2). Since this bird is somewhat emancipated from the immediate vicinity of water, the solitary record at the island on February 27 should not be taken as representing its local status.

9. **Crested Serpent-Eagle,** *Spilornis cheela* (Latham).

Next to kites and vultures, serpent-eagles are among the commonest raptorial birds of the Sakleshpur region, being seen alike in areas of heavy and moderate rainfall. The three eagles noted over the island on February 27 circled past at a low elevation with much screaming, as if a 'triangular' courtship were in progress. They took no evident notice of the swallow-plovers, but there is no valid reason to discount serpent-eagles as potential predators in their occasional passage over the nesting site.

10. **Pariah Kite,** *Milvus migrans* (Boddaert).

Like the Jungle Crow, Pariah Kites were seen at or near the island far more frequently than listed in my note-book. The one recorded on January 22 was mentioned because it alighted and drank from the river. Brahminy Kites, *Haliastur indus* (Boddaert), were also numerous in the vicinity, especially over paddy fields along the east bank. Both species of kite must be regarded as constant threats to breeding swallow-plovers, not merely to their eggs and variously grown young, but to the parent birds themselves. But no evidence to support this opinion can be advanced from field observations.

11. **Pied Harrier**, *Circus melanoleucus* (Pennant).

An adult male of this species flew over the island on January 22. Hitherto unrecorded from Mysore State, this species had, I believe, already appeared twice through my binoculars,—once in the previous winter in Sakleshpur, and once during that same season high over Bangalore. In the latter instance my attention was drawn to the soaring bird by the sudden upturned eyes of pet pigeons that were ingesting driveway gravel. As an aside, I recommend the keeping and close observation of domestic poultry to those who wish to spot high-flying birds—no better look-outs exist.

Marsh Harriers *Circus aeruginosus* (Linnaeus), although not recorded in my notebook, were seen also to visit the Sakleshpur island, occasionally alighting to drink from the river. Neither species of harrier is likely to have had an ecological relationship with swallow-plovers.

12. **Small Swallow-Plover**, *Glareola lactea* Temminck.

This, the chief breeding species of the Sakleshpur island, has been selected as a centre around which to relate other birds occupying the same habitat. Yet so far as can be determined, the swallow-plovers lead a serenely detached existence in which other species may come or go without making a scrap of difference.

Actually the swallow-plovers must afford one of the best available lessons in the danger of taking field observations to one's anthropomorphic heart, for the apparent placidness of these birds is no sure indication that they are not vividly and vitally aware of each impending danger to themselves and their colony. A snail, threatened by a blackbird, may appear equally unperturbed, but in that case we may be confident that the snail has no premonition of its danger. But when a warm-blooded vertebrate, especially a bird, is concerned, we are accustomed to think of it in terms of a scatter-brained hen or even a frantic mouse. Nevertheless it cannot be proved that tranquillity may not be a species trait entirely compatible with such awareness of danger as characterizes more demonstrative forms. Actually such tranquillity in some cases may have definite survival value to the species, so that it comes to denote as important a protective device as the more conspicuous manoeuvres for defence or escape of such noteworthy, if diverse, organisms as mice, muntjacs and women.

Following the disappearance of swallow-plovers from the Sakleshpur island during the southwest monsoon of 1951, no systematic attempt was made to ascertain the date of their return, since it was not known with assurance that this species uses the same nesting site year after year. Their continued absence on 20 November, when the island was again exposed, may be an indication that such birds practise a distinct annual migration to an alternative habitat, but as will be disclosed in the next paragraph, this conclusion cannot be drawn from my field data.

On 22 January, 1952, the island was again devoid of birds. But about one furlong upstream, towards Sakleshpur, I came upon thirteen swallow-plovers on a different island. It occurred to me that they might have been at this site when I visited the river two months previously, for on the former occasion I limited my inspection to the breeding island.

The swallow-plovers were all resting on the sand, most of them near the water-line. Nine were on the island itself and four were on the opposite bank of a narrow channel. They sat with their breasts facing the sun, but they turned their heads to watch me if I were not in a direct line with them. They rested singly for the most part, although there was one group of three within a foot of one another. The others were scattered five to ten yards apart. The birds were squatting on the sand, one of them in a natural depression, but gave no sign of being (or pretending to be) incubating parents. They were not at all disturbed by my presence and allowed me to get within the closest range of my 8x binoculars. Even then one bird merely walked away a few steps, rather than flying.

One swallow-plover that I disturbed flew some distance and landed in front of another one. As it alighted it bent forward in a deep bow, as if it had stopped too quickly and had 'nosed over' like an airplane. I could not see the other bird's immediate response, but they next walked rapidly past one another, turned, and again walked rapidly past one another. One of the birds then withdrew to a distance of several yards. No other symptom of awareness of one swallow-plover about other swallow-plovers was displayed. I did not hear any of the flock make a sound.

The birds may have been on this island because of human activity (dhobies and fishermen) on the breeding island at the time. They clearly exhibited no activity suggesting early territorialism at a nesting site.

Now that it was known that the small swallow-plovers had 'returned' to Sakleshpur, observations were carried out more regularly and, when possible, in greater detail. A brief visit on 30 January, revealed the birds as still present on the upper island. A group of six were sitting at intervals of about a foot from each other. The rest were scattered. One, on a small sand-bar below the island, had 'the gapes,' repeatedly turning up its head and spreading its mandibles to their maximum extent. This behaviour was not observed again.

On 7 February two swallow-plovers were found on the breeding island, while at least eleven could be counted on the upper one. They were definitely more scattered than previously. However, they still showed no resentment towards me or any social behaviour among themselves, other than the fact that they formed an assembled flock.

On 27 February twenty to twenty-five swallow-plovers were present, all of them now on the original breeding island. The considerable increase in numbers, plus the return of all birds to a former nesting site, were suggestive of an influx of native birds from an extended sojourn elsewhere. This is perhaps the strongest argument that can be offered in favour of the theory of an annual—if local—migration by members of this species.

A number of scooped-out hollows in the sand were observed where the swallow-plovers had been resting. But the birds did not behave aggressively or defensively, being on the whole undisturbed by my presence. Perhaps scooping out false nests at this season is a harbinger of stronger urges soon to be felt. Another portent of increased activity was a soft rasping note, uttered infrequently however.

On 13 March many depressions in the sand, but no eggs, were noted. The eighteen swallow-plovers seen were well scattered over the island, some in pairs, others singly or in small groups. They behaved as if slightly disturbed, gave a few mild whistles and flew about a bit.

This behaviour, considering the undemonstrativeness of swallow-plovers, should probably have been interpreted in terms of high passion, for on the following visit to the island on 29 March the first nest of the year was discovered. It contained only one egg, but it was among a large number of scooped-out hollows that appeared to represent the center of impending reproductive activities. This precocious egg antedates Major Pythian-Adams's clutch from an island in the Cauvery River by only twelve days (2), so that a highly consistent annual rhythm in breeding biology of swallow-plovers in Mysore State seems to have been outlined.

The nest hollows on the Sakleshpur island, begun long before the appearance of eggs, may have served as more than stimuli to dormant sexual urges, for there was evidence that they were being used at night for sleeping purposes. Many of them had collections of fecal material at their centres, or frequently at a point near the edge. Since swallow-plovers, as observed by day, were usually seen near the margins of the island, fecal accumulations must have been deposited during the hours of night. Nesting- or sleeping-hollows were situated close to the centre of the island. Some of them appeared to have been made entirely by the birds, while others looked more like old cattle, buffalo or human foot-prints that had been adapted for use with the least possible amount of architectural modification.

The evidence of fecal accumulations in hollows indicated that each bird might occupy more than one such dormitory on successive nights, for the number of hollows with signs of tenancy exceeded the number of birds—twenty-one—that I was able to count on this occasion.

Most of the hollows, including the one containing an egg, were in gravelly parts of the island, although there were both gravelly and sandy stretches in equally elevated and otherwise ideal places. The actual nest and the other hollows were five or six inches in diameter and about an inch to one-and-a-half inches deep. I could not discern that the birds brought any extraneous material whatsoever to contribute to the construction or decor of their nests.

The behaviour of the swallow-plovers remained sedate on this occasion, despite the fact that many of them must have been on the verge of laying eggs. They sat about in groups and moved only when I approached closely. Then some flew a short distance, while others went as far as the lower end of the island. There were no outcries of wing-dragging. The owners of the egg could not be distinguished by their differential antics.

Between 29 March and 14 April something must have happened at the breeding island to cause a profound disturbance among the swallow-plovers. On the latter date I first saw no birds at all, but soon I discovered about twelve of them on a small island just above the main one (not the upper island mentioned in January).

At the site of the nest found on 29 March on the main island a swallow-plover flew about near me calling, but I could not find the nest. The bird seemed agitated. I found no other nests here and the scraped hollows seemed not to have been recently worked. At the small upper island I found three nests with two eggs and one nest with one egg. The birds were excited, flying about calling or else squatting on false nests or feigning injury. They did not drag 'broken' wings, but settled on the ground and beat both wings simultaneously against the sand. They would often run for short distances and again feign injury to entice me away.

This island was not built up as high above river level as the main breeding island. It was also less gravelly, consisting principally of a mixture of sand and mud. The color blended with that of the eggs, but owing to texture of the ground, eggs were easy to see. Some nests were next to land-marks such as sticks or wisps of grass, others not so related.

A few swallow-plovers were feigning injury on a still smaller island just upstream from the current nesting area, but no nests or eggs were found there and it is possible that the birds were merely trying to draw me farther away from the new breeding site.

There were no marks on the original breeding island to indicate why it had been abandoned so abruptly. Since most of the female birds must have been on the point of egg-laying, a strong stimulus would be required to force them to seek other nesting territory at such a time. The fact that only twelve birds remained nearby also points to a major deterrent event at the main island, so violent that some of the birds left the area entirely. Presumably the ones that merely moved upstream for a short distance must have scooped out nests and laid eggs almost at once.

Between this visit and my next one on 28 April, Sakleshpur received its first annual 'blossom showers', eagerly looked forward to by the coffee planters. This rainfall, which may be heavy although of short duration, further obscured the history of nesting swallow-plovers. For on this day no nests were to be seen and only four birds remained in the vicinity. These were at the recent breeding site and behaved like nesting birds, flying about calling, or alighting with 'false nest' actions. No young birds were found despite a careful search in an environment that afforded almost no chance for their concealment.

It appeared inescapable to me that tragedy had overtaken the colony. If young birds had been fledged, at least the twelve adults seen two weeks previously should still have been present. Perhaps a heavy shower had caused a sudden temporary rise in the river and washed away the eggs and young. Or perhaps the negative force experienced at the main island had now been directed at the new breeding area; if so, all traces of its nature had been obliterated by the rain. Former nests could not be identified in the sand and even what appeared to be numerous recent buffalo or bullock tracks could not be ascribed definitely to that category.

On 12 May there had again been several heavy showers. No swallow-plovers were at the recent breeding site, but I located three pairs near the spot where they were first seen in January, 1952. They behaved in a slightly 'territorial' fashion but not like nesting birds. No fledglings were present.

On 29 May twelve birds were seen at the January site. No fledglings were among them and they behaved in an unconcerned manner.

The 1952 monsoon set in early in June, and on my next visit to Sakleshpur all the islands in the Hemavati River were submerged.

By 25 September it was again possible to search the river banks and some of the islands. On this occasion I took pains to look up and down stream for a considerable distance beyond the breeding center but no swallow-plovers were found. It would seem that they really do go elsewhere during the monsoon.

13. **River Tern,** *Sterna aurantia* Gray.

This species has been seen along the river on more occasions than the single listing of its presence on 22 January in this series of notes. A pair was observed several times in 1951, but it is doubtful that they nested within the narrow spatial limits of my survey.

14. **Blackbellied Tern,** *Sterna melanogaster* Temminck.

Major Phythian-Adams's failure to find a nest of the Blackbellied Tern prompts me to cite the first breeding record of the species in Mysore State. In Table 1 it will be seen that at least one pair of these terns was resident constantly at Sakleshpur.

On 20 November it was noted that the terns were in breeding plumage, having by this time recovered from their post-nuptial appearance.

On 7 February both birds flew close over my head, one of them uttering a short nasal '*a-a-a*'. This was on the swallow-plovers' breeding island and at a time of year when the latter birds were still behaving in non-aggressive fashion. The terns were definitely courting. One alighted on a sand bar and the other went off to fish. Presently the second one caught a minnow and brought it to the sitting bird. But instead of giving up the fish, the captor immediately flew away with it, as if inviting pursuit. The sitting tern followed half-heartedly and soon landed on another sand bar. This time the fisherman came down and yielded the minnow, whereupon the recipient dashed off with it, the donor following in enthusiastic chase. The game of tag was quickly over and the terns reverted to quiet behavior.

Although three birds were present on 27 February, two of these were obviously already a mated pair. These two were agitated by my presence and swooped so close to my head that I could hear the wind in their wings as they veered away. One did the 'broken-wing act' on the swallow-plovers' island, although I could not find a nest.

The terns sometimes dived at a group of swallow-plovers and put them to short flight. They also chased a Jungle Crow from the island.

It was therefore not astonishing on my next visit, 13 March, to locate a tern that was brooding over a newly-hatched chick on the swallow-plovers' island. The baby was in a hollow in the sand that resembled a true nest. However there were no signs of egg shells or of other chicks. The parent birds dived at me in great dismay but did not resort to subterfuges to lure me away. On my quick withdrawal one of the birds returned promptly to shade the chick, for the sunlight was strong.

On 29 March only one tern contested my presence, but it did so vigorously, and I concluded that the chick was concealed somewhere nearby.

The next visit, on 14 April, was on the day that I discovered the first disruption of the swallow-plovers' colony. Two terns were on the same small island to which the swallow-plovers had moved, but as this was separated from the first breeding area by a deep, swiftly-flowing channel, it seemed unlikely that fledgling terns could have accomplished the crossing. The adult terns flew about me to some extent and called, although they were not nearly so demonstrative as on my last two visits. One was carrying a small fish. The chick was not seen.

Terns were not noted on 28 April. On 12 May the pair that was present gave me a cursory inspection, uttering one or two cries, and then flew off. The pair seen on 29 May was merely noted as present in breeding plumage. No terns were seen on 25 September after the southwest monsoon. It is probable that the Sakleshpur pair of birds failed to rear even a single chick and that they left the region during the rainy season.

Relation to swallow-plovers: Nesting terns of either species should help to protect swallow-plovers' nests by their own aggressive behaviour toward intruders. However we here encounter two opposed methods for accomplishing the same end, for the swallow-plovers' lack of exhibitionism, which may cause them to be overlooked, must be counteracted in some degree by terns' behaviour that is very conspicuous indeed during the birds' efforts to drive enemies from the spot.

There is no evident competition for food between terns and swallow-plovers, since terns subsist chiefly on fish while swallow-plovers hawk insects on the wing (3). Hence their common breeding ground could result in strife only if it became over-crowded, which was not the case at Sakleshpur. The occasional diving at swallow-plovers by terns during my visits to the island cannot be interpreted as evidence of antagonism between the two species; the manoeuvre resembled an act of hyper-excitement on the part of the terns and did not arouse a strong response in the swallow-plovers. The harrying of a Jungle Crow over the island by terns would be of definite value to swallow-plovers and any other species sharing the habitat for breeding or other purposes. Terns may be considered, on the whole, as distinct ecologic assets in the economy of swallow-plovers, failing in their beneficial potential only by virtue of their rarity.

15. **Little Ring Plover,** *Charadrius dubius* Scopoli.

Census figures for this species along the Hemavati River do not suggest that the northern form, *C. d. curonicus* Gmelin, was present during the winter months, although Sálim Ali collected it at that season in his survey of Mysore State (2). On the contrary, ring plovers were more scarce in January and February than in the breeding season later on. Hence Sakleshpur birds can probably be ascribed to the resident subspecies, *C. d. jerdoni* (Legge).

The first evidence of nesting activity was observed on 27 February, when several pairs of birds were on the swallow-plovers' island or on near-by sand bars. On this date one bird was seen to squat as if on a nest, although investigation proved that this had been a deceiving manoeuvre. However on 13 March only one ring plover was detected. On 29 March two pairs were present, and on 14 April, observing the same number of birds, I found one nest with three eggs on a sand bar flanking the main island near the west bank of the river. On withdrawing from the nest, I saw a parent bird quickly return to the eggs and stand over them to provide shade. The nest was partly overhung by a small clump of grass.

As will be disclosed in a moment, it is not possible to state whether the clutch was complete at this time. In both Whistler's book (3) and Sálim Ali's 'Book of Indian Birds' (4) the full clutch of the Little Ring Plover is given as four eggs, but Major Pythian-Adams's set from Mysore State, taken at the same time of the year, consisted of only two (2).

On 28 April, the date on which all the swallow-plovers' nests had disappeared, the Little Ring Plover's nest had also vanished and I saw only one bird close by. The abundance of ring plovers—12 birds—on 12 May was associated with breeding behaviour on the part of some of them, although no nests or chicks were located. Perhaps some of the plovers were recently-fledged young that I failed to distinguish from their parents.

Relationship to swallow-plovers: Little Ring Plovers, being of mild disposition, appear not to impinge on the equally placid swallow-plovers. The two species commingle in harmony without evident competition or conflict from any standpoint.

16. **Redwattled Lapwing**, *Lobivanellus indicus* (Boddaert).

During cold weather lapwings were commonly met along banks and sand bars of the Hemavati River. But there was no occasion later, when the breeding season approached and arrived, to suspect that nesting of lapwings on the island was imminent, although the behaviour of the remaining pair or two strongly indicated that they were rearing young in the environs of paddy fields east of the river. Nevertheless the lingering sentinels performed good service to the swallow-plovers when they foraged on the island, not only by their alarm notes on any pretext whatsoever, but by their active pursuit of Jungle Crows. On 12 May the lapwings challenged not only me, but harried a crow until it took refuge in a thick tree on the eastern bank. Even then one of the lapwings continued to make sallies at the lurking bird but was unable to move it from its sanctuary.

Relationship to swallow-plovers: No direct association between species observed; certainly not a competitor. Sentinel activities are in the same category as those of the terns, viz., beneficial if it helps swallow-plovers to be surrounded by noisily conspicuous and aggressive species.

17. **Green Sandpiper**, *Tringa ochropus* Linnaeus.

This species may have been more common along the river in winter than noted by me, since it was only during the period of these observations that I first identified it.

Relationship of all sandpipers to swallow-plovers: No evidence of any association whatsoever was noted except in the possible case of Greenshanks' activities as sentinels.

18. **Common Sandpiper**, *Actitis hypoleucos* (Linnaeus).

No new observations were made on this species.

19. **Wood Sandpiper,** *Tringa glareola* Linnaeus.

No comments can be made.

20. **Greenshank,** *Glottis nebularia* (Gunnerus).

The opinions of Sálim Ali that this is a rare winter visitor and of Major Phythian-Adams that it is only occasionally seen (2) are belied by my experience at Sakleshpur (see Table 1). The occurrences of one bird on 12 May and three on 29 May are surely late dates for a 'winter visitor'. However the species had not returned by 25 September, 1952. My experience with Greenshanks seems obviously to illustrate the lacunae that exist in the knowledge of birds of Mysore State—gaps that cannot possibly be filled by brief collecting or observational surveys, but that can be bridged only by prolonged residential studies. Alas that I cannot serve further in this respect, and that bird-watching in Mysore State seems to have no other advocates!

21. **Temminck's Stint,** *Calidris temminckii* (Leisler).

A certain confusion regarding this species exists in my mind, since I first identified all stints at Sakleshpur as Little Stints, *Erolia minuta* (Leisler), on the basis of Sálim Ali's record (2). When I became aware of written descriptions of Temminck's Stints, however, I began to make careful field studies of individual birds. It then transpired that all the specimens that I could approach to the point of straining my eyes through the minimum focal adjustment of my binoculars had white outer tail feathers and greenish legs. There is no assurance that Little Stints did not occur at Sakleshpur, but the Temminck's Stints listed in Table 1 were all satisfactorily identified and constitute a new record for Mysore State.

Loose flocks of stints along the Hemavati River sometimes numbered as many as a dozen or fifteen birds, the first ones being noted on 22 January.

22. **Whitenecked Stork,** *Dissoura episcopus* (Boddaert).

Not met with by Sálim Ali's survey (2), but seen rather frequently by me in Mysore State. The pair that was present on the island on 7 February had obviously alighted only to spend the mid-day hours and had no relationship to the swallow-plovers' present or future activities (not that they would have refused to snatch up a half-dozen chicks or eggs, had they been available).

However the storks provided an amusing twenty minutes for me, since I was able to observe them at close quarters for the first time. I approached within about 100 feet of the birds, causing them to retreat slowly. They either walked ahead or flew across small channels, not seeming alarmed. Once when they came down they began to sun themselves. One bird rotated the wings forward so that the lining was uppermost. The wing-tips then touched in front of the stork, and the lining of the wing was therefore horizontal. It stood on one leg the while. The stork looked as if it were holding up an apron to receive a load of potatoes. Then both birds stood with their wings properly folded but held out at an angle of about thirty degrees from the body. They looked then like penguins on stilts, the wings resembling flippers. Finally the storks flew away and soared in high circles. Their wing positions while perched may have been antics related to the dissipation of heat, for it was a hot day, particularly warm on the sand bar.

23. **Little Egret,** *Egretta garzetta* (Linnaeus).

More common than noted in Table 1. No relationship to swallow-plovers could be noted.

24. **Little Green Heron,** *Butorides striatus* (Linn.).

The single specimen seen on 30 January, constituting the second sight record for Mysore State, was perched on a low branch of a tree overhanging the east bank of the river. On my disturbing it, it flew to a similar perch not far away, bobbing its tail upon alighting. Observation through 8x binoculars at close quarters was entirely satisfactory to me.

DISCUSSION

Whistler (3) cites the rising level of rivers as chief among the dangers to nesting swallow-plovers. To this opinion I freely subscribe in view of my own brief observations at Sakleshpur and my resultant suspicions. However the foregoing account suggests that there may occasionally be incidental factors that contribute to nesting failure. An attempt to evaluate all the forces is presented in Table 2. Briefly summarized, the adversities may be defined as:

1. Exposure of eggs and fledglings to excessive sunlight at times when human beings or other intruders wander into the nesting area.
2. The possible direct notice taken by human beings of nests and young as the resultant of parental displays of anxiety, whether by swallow-plovers or by associated nesting species, presumably more often the latter.
3. Opportunity for predators, especially crows and kites, to rob nest while adult birds are disturbed by intruders.
4. Accidental destruction of nests by wandering cattle and buffaloes, or those driven to the breeding island by their owners.

It is mysterious how swallow-plovers are able to survive. Observations to date would make it seem of particular interest, from the standpoints of evolution and ecology, to study this species carefully in an effort to define its suitability for survival, including: defence against enemies, food habits, relation to other birds and selection of breeding habitat. So far, only island nesting emerges as a protective form of behaviour, but this seems insufficient to account for species survival, especially in colonies such as the one at Sakleshpur. Furthermore, adherence to unfavourable breeding grounds, as at Sakleshpur, also seems disadvantageous. Man, perhaps, is a most significant enemy. If so, swallow-plovers may soon become a vanishing species. On the other hand, they must have survived for centuries with mankind as at present represented by rural Indians along India's rivers.

TABLE 2

Presumed potential relationship of associated factors to Small Swallow-Plovers on an Island in the Hemavati River near Sakleshpur, Hassan District Mysore State, in 1952.

Beneficial	Innocuous	Harmful
Large Pied Wagtail ...	White Wagtail	Man
River Tern ...	Malabar Crested Lark	Cattle
Blackbellied Tern ...	Pied Kingfisher	Buffaloes
Redwattled Lapwing ...	Common Kingfisher	Jungle Crow
Greenshank ...	Brownheaded Stork-billed Kingfisher	Crested Serpent Eagle (?)
Island Breeding ...	Whitebreasted Kingfisher	Pariah Kite
	Pied Harrier	Brahminy Kite
	Marsh Harrier	Climatic Factors
	Little Ring Plover	
	Green Sandpiper	
	Common Sandpiper	
	Wood Sandpiper	
	Temminck's Stint	
	Whitenecked Stork	
	Little Egret	
	Little Green Heron	

SUMMARY

1. An account of the annual cycle of Small Swallow-Plovers, *Glareola lactea* Temminck, in 1952 is given against a background of brief observations during the previous year at Sakleshpur, Hassan District, Mysore State, India.

2. It is attempted to demonstrate the ecologic relationship of this species to other birds observed on the breeding island, as well as to intruding men and animals and to climatic factors.

3. The evidence suggests that breeding species—swallow-plovers, terns and ring plovers—all failed to rear young in the 1952 season.

4. Reasons for nesting failure could not be defined, although several possibilities are suggested.

5. The evidence suggestive of local annual migrations of swallow-plovers in South India is considered.

6. Temminck's Stint and the Pied Harrier were recorded for the first time in Mysore State, while a second sight record of the Little Green Heron was obtained.

7. The first known instance of nesting of the Blackbellied Tern in Mysore State is recounted.

8. Modification of opinion of the status of several other birds in Mysore State is suggested.

9. The seasonal succession of birds in a habitat restricted to a small river island is traced from winter to the onset of the south-west monsoon. Many of the birds listed were only incidental visitors. Others participate in the ecology of inhabitants of the island.

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THE DETERMINATION OF AGE AND GROWTH OF FISHES OF TROPICAL AND SUB-TROPICAL WATERS[1]

BY

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In modern fishery investigation the determination of the age and rate of growth of fish occupies a very important place, since the knowledge of the age and growth is of notable significance from both scientific and commercial aspects. The evaluation of age provides a means to understand the composition of a fish population with regard to the age classes and to find the role of particular year classes in the fluctuations of the stock. The study of the growth-rate of fish leads to an effective and conclusive assessment of the sustaining power of the stock in a fishery, viz., a stock of fast growing fish can sustain a more intensive fishery than one of slow growth by its ability for fast recuperation. The determination of the rate of mortality of the different year classes, their survival rate and success of the individual year broods, that are of fundamental importance in the forecast and scientific exploitation of a fishery, are based on the knowledge of the age and growth-rate of the fish. The beginning of this century saw Norwegian workers engaged in a detailed study of the age and growth-rate of commercially important fishes like the Cod, Herring and Salmon. This was followed by several fishery workers in Europe and America working on many commercial and non-commercial fishes. Based on a detailed study of the age and growth-rate and the fluctuation of year classes in the population, short-term forecasts are made in recent years with reference to fish whose biology has been fully studied.

All this development in fishery research has been so far restricted to the temperate waters. There have been a few individual attempts to determine the age and growth-rate of some fishes in tropical and sub-tropical waters. An attempt is made in this paper to review this work.

AGE INDICES

The principle of age determination in fishes depends on the 'annual' growth marks that are formed in certain skeletal parts of fish, like the scales, otoliths and bones. These growth marks are really the growth checks formed on skeletal parts as a result of fluctuations in the growth of the fish. The growth of a fish, normally, is not uniform throughout the year or its life. The fish grows fast during a certain part of the year and slower or even ceases to grow during another part of the year. This fluctuating periodicity of fast and slow growth of the fish expresses itself annually on the skeletal parts of the fish as a periodic structure of fast growing (i.e., wide) and slow growing (i.e., narrow) zones. On the scales

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the fast growing zones are represented by wider sclerites or circulii and the slow growing zones by narrow sclerites arranged very close together in the form of bands or rings. The fast growing zones on the otoliths and bones are broad, opaque and white regions and the slow growing zones are narrow, thin and transparent ones. European and American ichthyologists have more or less established that these rhythms of growth are seasonal and that there is a very close relation between the periodic structure of the skeletal parts and the growth of the fish. The difference of opinion amongst the various workers has been mainly on two questions.

1. In several instances the skeletal structures show some secondary rings besides the normal 'annual rings'. The doubt has been as to the qualifying characters of an annual ring and a secondary ring.

2. The causative factors that are responsible for the formation of the growth checks or the 'annual rings' on the skeletal parts of the fish are still not known.

Monastuirsky (1926), Graham (1929), Van Oosten (1929) and Menon (1950) have reviewed the opinions of various workers on the first question.

Causative Factors in the Formation of the 'Annual Rings'

A short summary of the interesting observations on the second question is given below since it is important to postulate the utility of the skeletal parts of tropical fishes in the evaluation of their age.

It has frequently been assumed that growth-rate is greater during the period of higher temperature. Lea (1911) observed in the young herring that the rate of increase in length deduced from the scales was greatest when there was a rise of temperature in spring but it fell off before the temperature attained its maximum. Fraser (1917) also made a similar observation in *Onchorhynchus tschawytscha*. Experimental work has been reported by Fulton (1904), Cutler (1918), Dannevig (1925), Thompson (1920), Gray and Setna (1931), Brown (1946) and Molander (1947). Fulton (1904) noticed that the growth-rate increased in fish kept in warm tanks during the winter. But Cunningham (1905) examined the scales of a whiting from Fulton's experiments and found that although this fish had been kept in a warm tank during the winter, 'the winter ring was recorded on the scale'. Cutler (1918) found that temperature was a controlling factor of sclerite width in the scales of *Pleuronectes*. A higher temperature produced wider sclerites corresponding to the so-called summer zone of the scale and lower temperature produced narrow sclerites or the winter zone of the scale. The experiments of Dannevig (1925), gave just the contrary results, that the sclerite width was greater at lower temperature and lower feeding. Dannevig (1925), Thompson (1926) and Graham (1929) observed that there was a marked correlation between sclerite width and growth-rate. Graham (1929) also suggested that 'the main maximum of growth-rate (with high sclerite width) is an inherent rhythmical response'.

No well defined summer or winter zones were noticed by Gray and Setna (1931) on the scales of *Salmo irideus* that had been fed continuously throughout the year. 'This fact seems to eliminate the suggestion that the periodicity of the circulus width found in other members of the *Salmonid* family under natural conditions is due to an inherent rhythm over which the environment has no control. It also suggests that temperature alone is not invariably a decisive factor.' They also found that abundant food could effect an increased growth-rate and that wide rings (summer rings) could be formed in winter as well. The scarcity of food caused a reduction in the ring width. Hoffbauer (1899) and Thomson (1904) attributed the formation of the annual rings on the scales to the variations in food supply. Dannevig (1925) found that the wider sclerites were formed in winter and narrow ones in summer. According to Duff (1929) there was a drop in the growth of the scales and the production of the circulii during the period of most rapid growth of fish and he attributed it to the diversion of energy to other parts of the body during the growth in length of the fish. Duff put forward a hypothesis that there is no growth of fish or scale in winter and the zone of broad circulii is formed during the first half and the zone of narrow circulii during the latter half of the growth season.

The assumption by Gray and Setna (1931) that the periodicity of an inherent rhythm has no part in the periodicity of the scale growth does not hold good for the brown trout (*Salmo trutta*) in which Brown (1946) found that the annual cycle of growth was clearly expressed on the scale with an autumn check. Brown observed that this was presumably the result of an annual physiological cycle of changes in the internal environment, possibly the variation of the secretion of an endocrine organ such as the pituitary gland . . . . 'Since this cycle occurred in the absence of variation of any environmental factor, it cannot depend on the existence of environmental time markers.'

The brown trout kept under controlled conditions became sexually mature at the same age and season as those of the same stock kept under natural conditions.

Hickling (1933) also held more or less similar opinion in his study of the hake in which he attributed the formation of the transparent zones on the otoliths to a physiological rhythm, they being laid down during the period of greatest physiological stress. 'In the mature fish this is the exhaustion due to spawning and in immature fish to its precursor in the innate physiological rhythm which can be detected in the somatic tissues.'

Molander (1947) made a detailed study on the formation of the annual rings in the otolith of the plaice under controlled hydrographical conditions in aquaria. He concluded that (1) 'the growth of the plaice is clearly less in an experimental aquarium with constant cold water than in one with constant warm water and (2) independent of the different hydrographic milieu in the cold and warm experimental aquarium, one finds in both aquaria a coincidental annual growth rhythm on the part of the plaice, which is reflected in the formation of the annual rings on the otoliths. This growth rhythm coincides with an annual rhythm in nutrient intake and is probably due to internal genetic causes.'

From the above it is clear that the causative factor in the formation of these growth checks is not yet very clear or conclusive. The main factor that emerges out of the experimental studies of Dannevig (1925), Thompson (1926), Gray and Setna (1931), Brown (1946) and Molander (1947), is that the role of temperature variations in the periodicity of the structure of the skeletal parts of the fish has been over-emphasised.

The narrow zones in the scales and otoliths of cod (Dannevig, 1933) and the transparent zones in the otoliths of hake (Hickling, 1933) and the supra-occipital crest of the Poor Cod (Menon, 1950 *b*) have been observed to be formed in the majority of the specimens during the latter part of the summer and autumn. In several other fishes these growth checks are laid down during the period of lowest temperature. This apparent contradiction in the relation of temperature to the formation of the annual growth checks itself throws doubt on the possible influence of temperature in the phenomenon of the periodicity of the structure of the skeletal parts of fish.

The role of the variations in food supply also appears to be indecisive. In *Salmo irideus*, Gray and Setna (1931) found that specimens which have been fed continuously throughout the year did not show any well defined summer and winter zones. Brown (1946) observed just the opposite, that, even in specimens kept under controlled temperature, food, light, flow of water, composition and aeration of water and amount of living space, the annual periodicity was markedly visible on the scales.

The observations of Graham (1929), Hickling (1933), Brown (1946), Molander (1947) and Menon (1950 *b*) suggest an inherent physiological rhythm as a more possible causative factor in the formation of the growth checks. Fage and Veillet (1938) suggested that the maturation of the gonads was generally followed by a decrease in the growth-rate. It has been noticed in several fishes that there is a decrease in the rate of feeding and amount of food consumed with the maturation of gonads (vide Hardy, 1924, Hickling, 1933, Menon, 1950 *b*). Food is an important factor in the growth of an organism and maturation of gonads is a momentous physiological event in the growth history of a fish. The reduced feeding and the maturation of the gonads occurring simultaneously may perhaps play a great and effective part in the periodic formation of the annual growth checks in the skeletal parts of the fish. In the Indian Chub Mackerel (*Rastrelliger kanagurta*) it was noticed that there was a decrease in the amount of food consumed with the progressive maturation of the gonads. Schneider (1910) has suggested that an internal factor is largely responsible for formation of rings in the scale of the herring. He defined this factor as the cessation of feeding at the spawning time 'associated with the drain on the reserves of the fish to supply material to the gonads; in short to a heavy excess of expenditure over income of materials' (Hickling, 1933).

LITERATURE ON THE AGE AND GROWTH-RATE OF TROPICAL AND SUB-TROPICAL FISHES

That growth checks similar to those found in the temperate fishes occur in the skeletal parts of tropical and sub-tropical fishes has been more than sufficiently proved by Mohr (1910), Hornell and

Naidu (1924), Chevey (1930), Devanesan (1943) and Nair (1949). The validity and the interpretation of these growth checks or age indices remain to be decided. None of these workers examined the problem on the basis of the critical analysis enunciated by Graham (1929) and Van Oosten (1929) which alone can substantiate the validity of the annual nature of the growth checks that they all presupposed in their studies. Mohr (1921) investigated the age and growth-rate of *Rasbora vulgaris* from Kuala Lumpur, *R. elegans* from Kuala Jalai, *R. daniconius* from Vakvella, Ceylon, *Trichopodus trichopterus* from Kuala Lumpur, *Barillus guttatus* from Pahang River, *Ambassis commersonii* from a river in New Pommern and *Polynemus indicus* from the north coasts of New Pommern. There are marked climatic changes of rainy period and dry period in Ceylon whereas the temperature and climatic conditions are uniform throughout the year in the localities in Malaya from where the fishes were collected. The examined species included in them both fresh-water and marine forms having either cycloid or ctenoid scales. In all of them Mohr found very well defined scales showing distinct and sharp zones just as in the temperate fishes. Mohr did not explain the validity of the annual nature of the rings. But it is clear from the data given by him that increasing length groups of fish could be arranged in successive groups according to the number of rings. Mohr refuted the idea that the rings were only the results of seasonal changes and temperature fluctuations.

Whitehouse (1923) made some interesting observations on the growth-rate of the young fishes of the Silvatturai Lagoon in their first year by length measurements and following the Peterson method of size analysis. He investigated the monthly growth-rate of *Gerres lucidus*, *Teuthis java*, *Gobius criniger*, *Lutjanus quinquilinearis*, *Lethrinus cinereus* and *Equula edentula* during the first year of the life of the young ones in the lagoon. It is unfortunate that this interesting study was not continued for the larger size groups.

The detailed study of the life-history of the Indian Sardine (*Sardinella longiceps*) *by* Hornell and Naidu (1924) gives certain interesting details on the question of the age and rate of growth of the fish. They studied the rate of growth of the oil sardine by size analysis and computed the age by the Peterson method which was further substantiated by the scale reading. From these studies Hornell and Naidu gave the average life span of the oil sardine as 3 years, the lengths attained being 14, 15.5 and 16.4 cm. respectively. According to this the growth increments of the oil sardines are 14 cm., 1.5 cm. and 0.9 cm. in every succeeding year of life. It is rather surprising that the growth-rate diminishes at such an alarming rate. I feel that this calculation is questionable and erroneous. The error must have naturally been due to the fact that Hornell and Naidu did not examine fully developed scales. In the scalimetric study of the age of fishes, several workers (Thompson, 1922, Oosten, 1929 and Monastiursky, 1930) have shown clearly that scales from different parts of the body of the fish give very different and conflicting readings. It may be that Hornell and Naidu did not examine the scales from the same part of the body of the oil sardine in all the specimens.

Ranga Rao (1934) followed the Peterson method in determining the growth of *Therapon jarbua* (Day) collected in the estuaries of Adyar and Cooum and the sea at Madras. The details of his work remain unpublished. In the abstract of his paper he maintained that the fish migrates into the sea in its second year to attain sexual maturity and that the growth is greater in its second year during its life in the sea than in the first year in the brackish water. The growth was also found greatest during the colder months of December to January. During the summer months of April to July it was slowest.

The otolith was found very effective and useful in the determination of age and growth of *Psettodes erumei* (Bl. Schn.) by Ranga Rao (1935). Rao observed successive zones of growth on the otoliths and these were demarcated distinctly and clearly. Like Nair (1950) and Mohr (1910) Rao also presupposed without valid evidences that these zones were annual. But unlike these two, Rao observed that in most specimens the otoliths showed distinct beginnings of the opaque zone at the outer edges during August and September, which period was found to be the height of the feeding season. It is indeed a pity that this paper also, like the previous, is available only in its abstract condition. Due to the absence of the detailed paper the details of Rao's work remain unknown.

The age of the oil sardine was again studied in greater detail by Devanesan (1943). He examined the scales of the oil sardine from the pectoral region, unlike Hornell and Naidu (op. cit.), who collected the scales from the middle region. The scales were mounted in egg albumen and glycerine. Devanesan noted that the scale of oil sardine 'does not suffer so much from supernumerary rings as from suppression or obliteration of its so-called "Winter rings" '. Still, vestiges of these rings are visible on the scales from which the real nature of the ring could be reconstructed. The age reading became more difficult with older age groups due to the greater obliteration of the rings on the scales. Devanesan's study was only a preliminary investigation which yielded sufficient results for a more detailed analysis of the problem. He calculated the growth of the oil sardine graphically and estimated the sizes of seven year classes.

Hora and Nair (1940) studied the growth of *Hilsa ilisha* in its earlier phase of life by observation in the settling tanks of Pulta Water Works. They found that the rate of growth in the first three months was rapid and then it declined. The fish reached a size of 12 in. in 10 months. They also examined the scales of a few adult Hilsa from Allahabad and found that scales of specimens of about 304 mm. showed 4 or 3 rings, those of specimens of 200 mm. and less showed one or roughly two rings and specimens of about 235 mm. showed 2 to 3 rings. Hora and Nair also observed from the nature of the edge of the scales that in April and May the cessation of growth takes place and this they attributed to the possible effect of low water level and scarcity of food in the hot and dry months. Hora and Nair's work revealed that in the life-history of fish there is a seasonal rhythm of growth.

Chacko, Krishnamurthy and Zobairi (1948) working on *Hilsa ilisha* observed that on the scales of the fish occurring in the Godavary Delta there were transversely arranged radii, the number of which corresponded to the length of fish in inches. Based on Job's (1942) assumption that the Hilsa grew at the rate of 1 in. per month, they observed that one radius was laid down per month on the scale. It is possible that the formation of the radii is related to a monthly physiological rhythm depending on the tidal periodicity as in the case of the maturation of the gonads noted in *Leuresthes tenuis* by Clark (1925) and *Enchelyopus cimbrius* by Battle (1930). The conflicting part of the paper of Chacko, Krishnamurthy and Zobairi, however, is that in the published diagram of the Hilsa scale, they have shown some transverse lines marked as 'radii' and four horse-shoe shaped lines spaced more or less at equal distance which are denoted as growth rings. What are these radii? What are these growth rings? Are they annual or half-yearly 'growth rings' or are they some spawning checks or marks impressed on them by their annual migration from sea to fresh-water and *vice versa?* The point requires a very detailed study and clarification and until then the conclusion that the number of radii correspond to the length of the fish in inches has to be regarded as a pure accidental coincidence.

Nair (1949) found the otoliths very useful in the age studies of the oil sardine (*Sardinella longiceps*). He treated the otoliths in a successive series of alcohol and xylol and then mounted them in Canada Balsam. When viewed with reflected light, he observed the growth zones as alternating translucent dark zones and opaque white ones, parallel to the margin of the otoliths. False rings could be picked out by their line-like appearance and by their tendency to join a growth ring. Nair presumed that these rings were annual, formed probably during December to April when scarcity of planktonic food has been noted. He is of the opinion that the life of the oil sardine is 3 years only and concurs with the findings of Hornell and Naidu. No indications are given as to how he considers these rings as annual. Perhaps more information will be forthcoming in the detailed account he has promised to make available soon.

Chacko and Krishnamurthi (1950) in their further studies on *Hilsa ilisha* of Godavary clarified the significance of the 'growth rings' on the scales observed by them in their earlier studies (1949). According to them there is a period of starvation concurrent with the spawning act, and during this period there is a general absorption of all the tissues of the body, the scale also being affected by the formation of a ring. A ring on the scale thus denoted a period of spawning and from the number of rings present on the scale the number of times the fish spawned could be determined. They inferred from this growth ring count that Hilsa spawned for a maximum of eight times in its life. The ring could not be treated as an index of age as it was not yet ascertained whether the mature Hilsa bred once every year or not.

Chidambaram (1950) in his studies on the length frequency of the oil sardine (*Sardinella longiceps*) examined the question of age from the basis of the predominant size groups. Following the methods of Heincke and Lea he examined the fate of the three predominant size groups in this fishery from 1937-38 to 1942-43. Based on this study Chidambaram concludes that 'the life of the oil sardine is between

3 and 4 years, the average lengths of the oil sardine being 10.0, 14.5, 18.3 and 20.5 cm.' in the respective years.

Chacko and Dixitulu (1951) examined the smaller size groups of *Hilsa ilisha* and again reiterated the findings of Chacko *et al.* (1948) that in *Hilsa ilisha* there is one radius on the scale for every inch in growth of the fish.

Sundara Raj (1951) supported the findings of Chacko *et al.* (1948) in the use of radii of scales to determine the age of *Hilsa ilisha*. Adducing evidence from the scales of *Hilsa ilisha* collected from different parts of India, Raj ventured to suggest that since the number of transverse radii corresponded more or less with the size of fish in inches and since this relation was found to be fairly constant, 'the radii in Hilsa scales should be used for age determination'.

Jones and Menon (1951) found that the scales started formation in *Hilsa ilisha* when the fish was 21 mm. in length. Commenting on the work of Chacko *et al.* (1948) they remarked that there was no correlation between the number of radii and the length of fish in inches and that it was difficult to accept the relationship between these two factors as drawn by Chacko *et al.* (1948). Jones and Menon have made observations on the appearance of the number of radii on the scales during the growth of the *Hilsa ilisha* in its larval and post larval stages. They observed one distinct 'growth ring' and two incomplete rings on the scales of a fish of 213 mm. in length. Their significance was left uninterpreted.

In the studies of the age and growth rate of the Indian mackerel *Rastrelliger kanagurta*, Chidambaram and Krishnamurthy (1951) used the otoliths. The number of growth rings on the otoliths had a close relation with the size groups. It was found too difficult to read the number of rings in the otoliths of specimens of 20 cms. and more in length.

Seshappa and Bhimachar (1951) working on Malabar sole (*Cynoglossus semifasciatus*) made certain interesting observations. They found clear rings on the scale which, by observation of the marginal nature of the scales, were found to be annual. They concluded that the rings were formed under the influence of the south-west monsoon season and thought it appropriate to call the rings as 'monsoon rings'. They correlated the check in growth to the depletion of food in sea bottom and opined that 'the lack of food leading to starvation' was the main factor in the formation of the rings. The work is of special importance as for the first time in tropical fisheries research has a proper method been employed and effort made to fix the validity of the annual nature of the rings. Seshappa and Bhimachar also observed that the otoliths showed no rings.

I am giving an abstract of Chevey's papers towards the end of this communication because of the critical observations in them that are of special interest to the work in our region.

Chevey (1930 *a*, *b*, *c* and 1932) made an interesting study on the value of the method of age determination by scales as applied to the fishes of Indo-China, Cochin-China and Cambodia. He found concentric zones of growth in the samples of *Synagris japonicus*, *Scolopsis bimaculatus*, *S. vosmeri*, *Pristipoma argenteum* and *Sciaena vulgaris* collected from Tonking in North Annam. But the samples of the same species collected from Cochin-China did not reveal any such zones of growth. He interpreted this variation as due to the occurrence of a winter condition in Tonking area and its absence in Cochin-China. The temperature of the surface water in Tonking and North Annam seems to be 27°C. to 28°C. in summer and 23°C. to 24°C. in winter, 'a difference of 4°C. to 5°C. seems to be sufficient to provoke the slowing of growth in fish and the marking of the scales'. He observed a similar phenomenon in the regions around Cape Varella. The species caught near Cape Varella showed a regular and continuous growth. Chevey attributed this to the effect of the cold current coming from the north during the north-east monsoon affecting only the coastal regions and not the bay. But in Cochin-China the fishes from the mouth of the rivers Meking and Bassac showed clear growth rings on their scales, a feature quite different from his previous observations on the fishes from the adjacent oceanic areas of the same regions. The reason for this, according to Chevey, is that during October to March every year, as a result of heavy rains, 'the Meking and Bassac put into the sea an enormous quantity of nitrogenous food material which provoke the temporary yet very thick concentration of the whole marine population of the neighbourhood. It appears to me without doubt that this rhythm of concentration and dispersion of the food material of the fish gives the marks on the scales, increasing the growth if there is a concentration provoked by abundance of food material and slowing of growth with the phase of dispersion'.

This phenomenon concurrent with the 'flooding' of the waters was further observed by Chevey in all the fishes of the rivers of Cochin-China and Cambodia and of the Grand Lac where all the scales of *Cyclocheilichthys enoploides, Albulichthys krempfi, Leptobarbus hoeveni* and *Labeo pleurotaenia* showed marks of this periodic rhythm. Chevey stated that 'the stoppage of growth occurs with the lowering of the water, which is the winter for these fishes physiologically'. He made very interesting observations on the effect of the flooding of the Grand Lac and Tonle-Sap. He found that in the scales of fishes from both these fresh-water areas, the growth checks occurred with lowering of the water level and as this lowering of water level occurred only once every year these checks were valid indices of the age of the fishes. He compared the rate of growth of *Labeo chrysophekadion, Hampala macrolepidotus, Leptobarbus hoeveni, Cyclocheilichthys enoploides* and *Puntius bramoides* from these two regions by a study of their scales and found that the specimens from Grand Lac showed a faster growth rate than those from the other regions. The reason he gave was that the Grand Lac during the flooding season overflooded thick verdant forest regions which provided a large amount of nitrogenous material for an enrichment of the food of the fish, whereas the Tonle-Sap overflooded only the fringes of such regions without any opportunity of enriching the waters with nitrogenous material.

These observations are interesting as they definitely agree with the findings in the temperate regions, that the temperature alone plays only a very indirect if not insignificant part in the stimulation of the growth checks. It might be of interest to compare the conditions that Chevey gave for the Indo-Chinese waters with those occurring on the West Coast of Madras Presidency. Chidambaram and Menon (1946) and Jacob and Menon (1947) have shown that there is a marked seasonal fluctuation in the surface temperature, salinity, total volume of plankton, copepods and diatoms in the West Hill sea. During the first part of the period of the south-west monsoon all the above hydrographic and biotic factors are at their lowest values. 'The environmental conditions in the inshore area during monsoon months (June to August) are quite distinct from those during the other months of the year and are characterised by a sharp fall in salinity and temperature, a high turbidity and turbulence and above all by the sea bottom becoming severely depleted of the organisms' (Seshappa and Bhimachar, 1951). The plankton production increases steadily after this period and the diatoms have their maximum period in August-September immediately after the enrichment of the region with the nutrient salts carried into the sea by the rains of the previous period. Following the diatoms there is the copepod maximum in the succeeding month. With the onset of the dry period the surface temperature and salinity increase culminating in the high temperature and salinity conditions of the summer months when the plankton production is at its minimum. In the studies on the oil sardine (Hornell and Naidu, 1924 and Devanesan, 1943) and the mackerel (Jairam Naidu) it was shown that the actual growth of these fishes occurred during the months of August to December when the region is very rich with planktonic food material. Hornell and Naidu (1924) observed that there was complete cessation of growth in the oil sardine during the months, January to May, i.e., the summer months. It has also been observed (Devanesan and Chidambaram 1949) that in the majority of the investigated fishes of the West Coast the spawning occurs during the monsoonic months just prior to the months of planktonic abundance. It is thus noteworthy that this period just prior to the monsoonic months when growth is actually arrested most possibly due to the maturation of the gonads and further aided by the lack of sufficient food material and the immediately succeeding period of monsoonic months when the temperature is lowered by 4°C. to 6°C. and when the actual spawning occurs, have in them all the possible ecological and physiological factors to impress the effect of this annual rhythm on the skeletal parts of the fish.

The observations of Delsman (1929) and Hardenberg (1939) are very sceptical on the question of determination of age in tropical fishes by the methods established in other climes. In fact Delsman (1929) opined that due to the 'absence of summer and winter' which accounts for the 'absence of winter rings on the scales of sea fishes', 'a very valuable method in studying the biology of fishes must consequently be abandoned', Hardenberg (1938) dilated on this opinion further and stated that due to the absence of any periodicity, year rings could not be ascertained and thus neither the growth nor the age of a fish could be made out. Without detailed examination of this important problem on the lines suggested by Graham (1929) and Oosten (1929), it is not possible to accept the statements held out by Delsman (1929) and Hardenberg (1938). It is a well-known fact that the index for age determination varies from fish to fish. In some the scales are useful, in others otoliths and in some others some specific bone. It is to be regarded as highly injudicious to accept that the growth of a fish in the tropics is uniform and that there is no rhythm in its growth in the year. There is periodicity in the physico-chemical and biological factors of the tropical waters. There is a periodic rhythm of spawning. It is not possible in the face of the periodicity of these various factors to accept that there is no periodicity in growth alone. The work of Chevey, Mohr, Rao, Seshappa and Bhimachar and several others given above completely go against these suggestions of Delsman and Hardenberg.

A critical study of the method using scales, otoliths and bones of the fish simultaneously and on the lines suggested by Graham (1929) is absolutely necessary to decide its validity in tropical and sub-tropical waters. It is also of interest to note that the conditions in tropical waters are extremely useful to decide the issue of the causative factor for the formation of these growth checks.

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THE ANALYTICAL CHARACTERS OF SOME OF THE MARSHY VEGETATION OF BOMBAY AND SALSETTE ISLANDS

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(*With a plate*)

INTRODUCTION

While studying the ecology of mangrove vegetation from several places in and around Bombay and Salsette Islands, (4, 5) it was thought to study a certain number of analytical characters for each assemblage of plants and association. Though early workers like T. Cooke (3), and Blatter (1) have described certain mangrove plants with their flowering and fruiting periods, no work has been done so far from the ecological point of view. Hence an attempt is made to record certain analytical characters of marshy vegetation as given in the Vocabulary of Plant Sociology (2).

These characters come under the study of plant sociology. It is mentioned in the Vocabulary that for each assemblage of plants and each example of the association a certain number of analytical characters can be obtained from direct observation.

These characters give an idea as to how far a particular species is abundant or dominating in a particular area, and thereby can withstand the vital competition which is more rigorous in more highly differentiated communities. The causes of competition are multiplied by several factors such as (1) number of species, (2) the diversity of biological forms, (3) the specialisation from the ecological point of view, etc.

There are a number of characters for the analytical study but in this work only the important ones are observed for this particular type of vegetation. The characters noted are (*a*) the dominance and (*b*) the sociability.

(*a*) Dominance: The correct idea of this term as given in the Vocabulary of Plant Sociology (2) is that it means the extent of the area occupied by or covered by the individuals of each species. Further the Vocabulary says that in the communities where there are several strata of vegetation, the dominance must be evaluated separately for each stratum. To evaluate the dominance, exact meanings have been given to the figures for each species as follows:

1 = Covering very feeble.
2 = Species covering from 1/20 to 1/4 of the area studied.
3 = ,, ,, ,, 1/4 to 1/2 ,, ,, ,,
4 = ,, ,, ,, 1/2 to 3/4 ,, ,, ,,
5 = ,, ,, more than 3/4 of the area studied.

But this method is only applicable to relatively small surfaces. So when larger surfaces are dealt with, like the present mangrove vegetation, a convenient scale was adopted which simplified the matter in actual practice about the two factors of abundance and dominance. The scale is as under :

+ = When the number of individuals and the area covered are both very small.
1 = When the number of individuals is rather large but the area covered is small.
2 = When the individuals are numerous and the area covered at least 1/20 of the surface.
3 = Any number of individuals covering from 1/4 to 1/2 of the area.
4 = Any number of individuals covering from 1/2 to 3/4 of the area.
5 = Any number of individuals covering from more than 3/4 of the area.

(*b*) Sociability: By this term the manner in which the individuals of the same species are disposed in relation to one another is expressed (2). Five degrees of sociability can be expressed as follows :

1 = Shoots (or individuals) growing singly.
2 = ,, ,, ,, in small groups.
3 = ,, ,, ,, in greater groups.
4 = ,, ,, ,, in small colonies.
5 = ,, ,, ,, in pure populations.

METHOD

The actual observations are made from the quadrat study of the area. The measurement was carried out by means of a thin white rope 40 meters long, and this was made into 10 meter square. The length of each meter was shown by a small knot to which a small wooden splint was tied. At every 10 meters (at corners) a rather bigger splint was used. When measuring a locality, a suitable spot was chosen and the measured rope was spread along upto 10 meters and then it was turned at right angle upto 10 meters and the process (of turning at right angle) was continued till the two ends met. Care was taken that the bends were at right angles so that a perfect quadrat of 10 × 10 meters was formed, and then the counting was carried out after noting the plants in the field book, symbolically according to the figures shown above. Then keeping one side fixed, the rope was adjusted to form another quadrat in a similar way. So in this manner a block of 100 sq. meters was covered each time, and thus a considerable portion of the vegetation was recorded. It must be remembered that as the vegetation was on marshy ground, it was sometimes very difficult to have all the four sides of the quadrat, covering the area. In such cases only three or sometimes even two sides had to be taken into consideration to make up the particular quadrat complete, and the area of the complete quadrat was estimated or rather judged by the eye. This is mentioned only to show the extent of handicaps under which a field observer, in such a wet or muddy soil (which is sometimes knee deep or even more), has to work in order to get a sufficiently accurate data in spite of such unsurmountable difficulties.

RESULTS AND DISCUSSION

From the tables (Appendix) it will be observed that the results are tabulated under 6 different headings, viz. (1) the date on which the reading was taken; (2) place and the actual spot of the locality; (3) dominance; (4) sociability; (5) the plant or the vegetation concerned; and (6) remarks as regards quadrat, flowering, fruiting, etc.

The first measurement was taken at Bandra (Table 1) towards the eastern side along the railway lines. Here the dominant vegetation is of *Avicennia alba*. *Aeluropus repens* grows also sufficiently on drier patches and the *Clerodendrum inerme* is poorly scattered. In the 2nd quadrat near the slaughter house, *A. alba* is thickly populated giving the figures for dominance and sociability as 5 : 5. The 3rd quadrat was taken on crossing the railway bridge, on the opposite side. Here *Sesuvium portulacastrum* gave the figures as 4 : 4. Towards Mahim side *Avicennia* recorded 4 : 4 with small patches of *Aeluropus repens* 1 : 2 in the 4th qdt. Still further towards the west the 5th qdt. gave 4 : 4 for *A. alba* and + : 1 for *Sonneratia apetala*. Near the vehicle traffic bridge the vegetation abounds in *A. alba* which is represented as 4 : 5 in the 6th qdt. In this way a sufficient number of quadrats were recorded wherever possible to get an idea of the vegetation. From these figures it is evident that *Avicennia alba* is dominant throughout this locality.

In Mahim (Table 2) nearly 22 quadrats were recorded, the first of which was along the railway lines on the western side. The area is nearly covered by *A. alba* giving figures 3 : 4 with one or two trees of *Sonneratia apetala* and a few scattered *Ceriops*. The 2nd qdt. was on the side banks and included *Acanthus ilicifolius* and *Avicennia alba* having 2 : 2 and 1 : 3 figures respectively. The 3rd qdt. was also on the side banks including *Clerodendrum inerme* vegetation having 1 : 3 figures. On the drier soils the 4th qdt. had *Aeluropus repens* as 2 : 3 and some patches of *Sesuvium portulacastrum*. The 5th one was taken towards the bridge road having 3 : 4 as figures for *Avicennia alba*, with little patches of *Aeluropus repens* and *Sesuvium portulacastrum*. Towards the east side from 6th to 15th qdts. *Avicennia* grows abundantly throughout, especially in 6th, 7th and 8th qdts. where a pure population or a pure colony is found. In 9th to 15th quadrats, due to a lot of human influence, where people cut the plants for fuel and other purposes, the population was not so thick as in the former cases. The 16th to 19th quadrats were taken near the shore of the creek. Even in the *Sesuvium portulacastrum* vegetation which in the 16th and 17th qdts. bore figures 4 : 4, *Avicennia alba* was found to bear 2 : 2 and + : 1, and *Aeluropus repens* had + : 2 and + : 1. In the 18th qdt. the vegetation was dominated by *A. repens* and *S. portulacastrum* having 4 : 4 and 3 : 3 figures respectively. This vegetation also bore *Avicennia alba* to the extent of + : 1.

Towards the west side 5 quadrats were recorded and they showed the *Avicennia alba* vegetation throughout with slight mixture of *Sesuvium portulacastrum* which can be easily marked from the table.

Thus in 23 quadrats covering an area of 2,300 sq. meters, the dominant species which can be noticed easily, was *Avicennia alba*, though sometimes patches of *Aeluropus repens* and *Sesuvium portulacastrum* occasionally occurred.

From Diva (Table 3) near the creek towards the north-east direction three quadrats were recorded. The 1st consisted of grass vegetation like *Sporobolus glaucifolius* and *Fimbristylis ferruginea* and the corresponding figures for dominance and sociability were 4 : 4 and 3 : 1 respectively. The 2nd qdt. consisted of *Aeluropus repens* and *Acanthus ilicifolius* which were in flowers and fruits, and the figures obtained for them were + : 1 and 1 : 2. The 3rd qdt. included *Ceriops* and *Sonneratia* having figures for both + : + and + : +. The *Sonneratia* trees had their flowers fallen down, and were in fruiting condition.

Still further along the creek, the 4th qdt. gave *Paspalum vaginatum* bearing figures 2 : 3 and a cyperaceous plant (having quadrangular stem) bearing 2 : 4 as the figures. The 5th qdt. bore *Aeluropus repens* and *Avicennia alba*, giving 4 : 4 and 3 : 4 as the numbers. *Avicennia* was found near the railway line and the grass on the drier land.

On the west and southwest side of the Diva-Mumbra creek, the vegetation chiefly consisted of *Acanthus ilicifolius*, occasionally interrupted with *Aeluropus repens* on the drier land, with a solitary bush of *Avicennia alba*. An almost constant number for *Acanthus ilicifolius* was 4 : 4 throughout all the area covered. The following numbers were obtained for the different qdts.

1st qdt.	*Acanthus ilicifolius*,	4 : 4	*Aeluropus repens*,	+ : 1
2nd ,,	,, ,,	4 : 4	,, ,,	+ : +
3rd ,,	,, ,,	4 : 5	,, ,,	+ : +
4th ,,	,, ,,	4 : 3	,, ,,	+ : 1

Towards the south east two more quadrats were possible, i.e. the 5th qdt. consisting of *Acanthus ilicifolius*, *Avicennia alba* and *Aeluropus repens* in the order 4 : 4, + : 1 and + : + respectively. The last or the 6th qdt. gave numbers for the above three plants as 4 : 3, 1 ; 1 and + : + respectively. The vegetation of *Acanthus ilicifolius* was in flowering and fruiting stage when the records were made, on 2–5–39. Again some 20 more qdts. were recorded on 21–5–39 which could give an idea of the vegetation which was mainly consisting of *Acanthus ilicifolius* with occasional small trees of *Sonneratia apetala* and patches of *Aeluropus repens*. This is clearly seen from the Table. This side of the area was dominated by *Acanthus ilicifolius* but in spite of this dominance, *Avicennia alba* was occasionally seen along with *Aeluropus repens*. Thus a keen competition was evident from the presence of *Avicennia alba*, even in spite of so much local dominating species like *Acanthus ilicifolius* and *Aeluropus repens*. This behaviour on the part of *Avicennia* further reveals that the plant tries to avail itself of every opportunity to establish itself anywhere in spite of the odds that come in the way.

Bhandup (Table 4), Vikhroli and still further towards Ghatkopar along the railway lines nearly 18 quadrats were taken, and it was found particularly in all the quadrats that *Avicennia alba* was dominating in these areas.

Similarly a number of quadrats were recorded from different spots on the Vadala shore (Table 5) right upto the oil tank pier and it showed that the shore had a pure population of *Avicennia alba*, on a major part of the area, though occasionally on drier land patches of *Aelujopus repens* could be noticed along with the main vegetation.

The numbers for the dominance and sociability in the area near Sion station along the Bombay Agra Road (Table 6) showed the *Acanthus ilicifolius* vegetation ; though on the opposite bank of the creek *Avicennia alba* seemed to be dominating. Nearly 15 quadrats at different spots were recorded.

Again a number of quadrats were measured in Thana (Table 7) along the railway lines, near the creek, in the south-east direction, near the creek shore and on the western side. It was noted that near the creek *Avicennia alba* dominated while on the drier soils patches of *Aeluropus repens* and *Sesuvium portulacastrum* dominated with the presence of *Salvadora persica*, *Acanthus ilicifolius* and *Sporobolus glaucifolius*.

A few measurements were recorded at Colaba (Table 8) reclamation area on 18-1-39. Here also the dominating species was found to be *Avicennia alba* with an occasional presence of *A. officinalis* which could be noticed from the (Table 8.) giving 4 : 4 for *A. alba* and + : 1 *A. officinalis* as the numbers for dominance and sociability. Due to muddy nature of the soil it was not possible to note a number of records, but whatever number of records taken, it clearly showed the dominance of *A. alba*.

The same difficulty was met with at Ghodbunder (Table 9) on account of knee-deep mud, to take a quadrat reading, and hence only a few records were possible which showed that the vegetation was not of one species of pure type of *Avicennia alba*, but was mixed with other mangroves like *Rhizophora*, *Ceriops*, *Acanthus*, *Sonneratia*, etc.

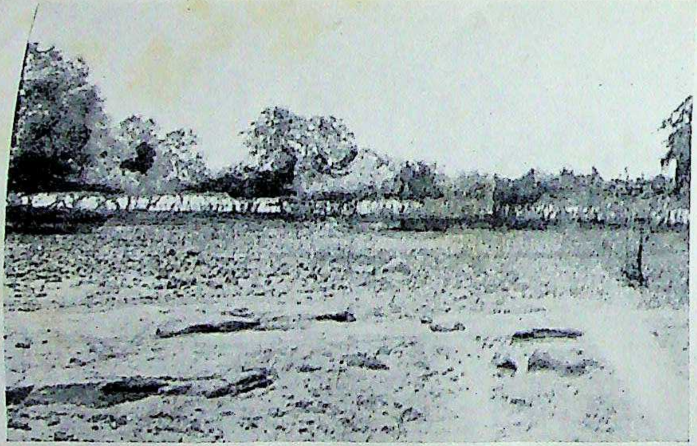
On the shores of Elephanta Island (Table 10) a few readings were made which showed that *Sonneratia acida* dominated on the eastern side having figures 4 : 4 and the interrupted patches of *Avicennia alba* having 1 : 1 as the number. It was further found that *Sonneratia* vegetation was about 15 feet behind the *Avicennia alba* vegetation from the shore. Patches of dry land bore grasses having numbers 2 : 1 and 1 : 1. Near Shetbunder *Avicennia alba* shrubs were found on the foreshore representing the numbers for the dominance and sociability as 3 : 2.

Similarly near the village (of the Elephanta Island) *Sonneratia* and *Avicennia alba*, even in spite of the destructive influence of human beings and animals the numbers were found to be 3 : 3 and 2 : 1 respectively thus giving an idea of the dominance and the sociability of the species that grew near the island.

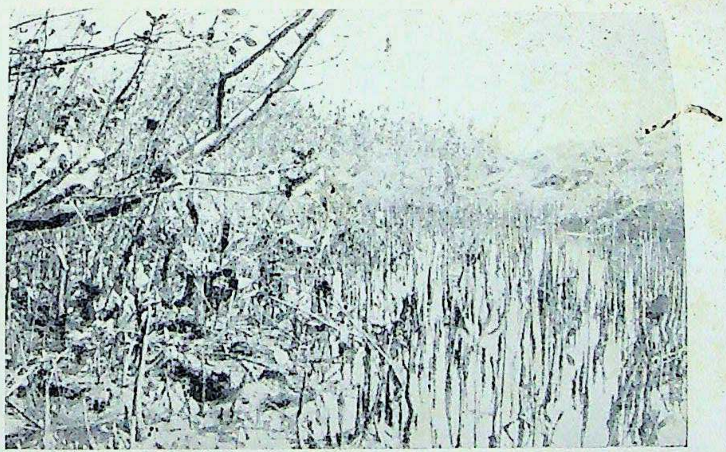
Quadrat records were made at Trombay (Table 11) along the railway lines near Chembur giving the number as 2 : 3 and on the east of the Trombay Hill near the shore the number came to 2 : 2 for *Avicennia, alba.* And also a few quadrats were noted from Mudh Island on the eastern side (Table 12) giving the numbers as 3 : 3 and 2 : 3 for *Avicennia alba.*

CONCLUSION

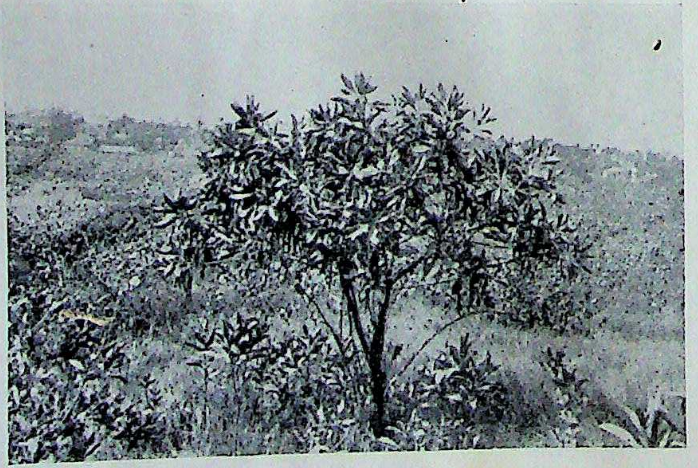
It was almost physically impossible to measure up all the area in all the places and localities, due to their situation and the muddy nature of the soil ; and hence to get a clear idea of the complete vegetation some



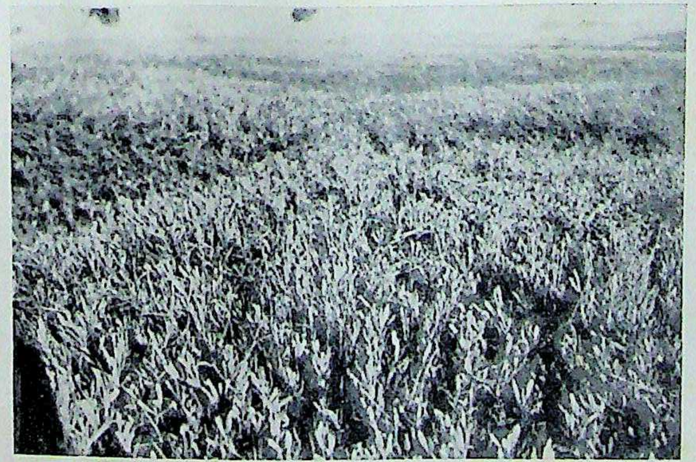
Avicennia alba trees from Uran



Sonneratia apetala and *Acanthus ilicifolius* from Mumbra



Rhizophora with its seedlings in the *Avicennia* vegetation
from Mahim-Bandra



Author

Sesuvium portulacastrum from Vadala salt pan area

extent of judgment and discrimination were required. Nevertheless, what actual measurements were made on the spot were quite sufficient to give a clear and definite idea about the type of vegetation and the dominance and sociability of the same. These observations showed clearly that (1) dominating mangrove vegetation in and near Bombay and Salsette islands in general was *Avicennia alba* with a few local exceptions in particular spots; and such spots were always present within such a large area of the big islands like Bombay and Salsette.

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APPENDIX

TABLE 1

Analytical characters of Marshy Vegetation of Bandra 10 × 10 Meters Quadrat

Date	Place	Dominance	Sociability	Plant	Remarks
30-7-38	Bandra along the Rly. lines towards NE.	3	4	*Avicennia alba*	In fruiting
		1	3	*Clerodendrum inerme* (bushes)	1st Qdt.
		2	3	*Aeluropus repens* (patches)	
18-11-38	Near slaughter house	5	5	*Avicennia alba*	2nd Qdt.
”	further towards west, beyond vehicular bridge.	5	5	” ”	3rd Qdt.
		4	4	” ”	4th Qdt.
		+	1	*Sonneratia apetala*	” ”
5-5-39	”	4	5	*Avicennia alba*	5th Qdt.
11 5-39	NE. side	3	2	” ”	6th Qdt. fls.
”	”	3	5	” ”	in pure 7th
”	”	2	5	” ”	8th Qdt. in pure colony.

TABLE 2

Analytical characters of Marshy Vegetation of Mahim.

Date	Place	Dominance	Sociability	Plant	Remarks
30-7-38	Mahim near bridge, towards east.	4	4	*Sesuvium portulacastrum*	1st Qdt.
18-11-38	Still further towards Mahim Railway Stn.	4	4	*Avicennia alba*	2nd ,,
		1	2	*Aeluropus repens*	,, ,,
,,	Still along the Ry. line.	3	4	*Avicennia alba*	1st ,,
		3	3	*Avicennia alba*	2nd ,,
,,	,,	2	2	*Acanthus ilicifolius*	with 1 or 2 *Sonneratia* & a few *Ceriops*.
,,	Still on dry soil	1	3	*Clerodendrum inerme*	
21-11-38	Towards vehicle bridge & road.	2	3	*Aeluropus repens*	(patches of *Sesuvium*) 3rd Qdt.
		3	4	*Avicennia alba*	4th Qdt. with little (patches of *A. repens S. portulastrum*. In pure population in spite of human influence, for fuel
11-5-39	Towards East.	3	5	*Avicennia alba*	1st Qdt
,,	,,	3	5	,, ,,	2nd ,,
,,	,,	2	5	,, ,,	3rd ,,
,,	,,	3	3	,, ,,	4th ,,
,,	,,	3	3	,, ,,	5th ,,
,,	,,	4	3	,, ,,	6th ,,
,,	,,	4	3	,, ,,	7th ,,
,,	,,	3	2	,, ,,	8th ,,
,,	,,	4	2	,, ,,	9th ,,
,,	,,	3	2	,, ,,	10th ,,
,,	East near the shore of the Creek.	4	4	*Sesuvium portulacastrum*	1st ,,
		2	2	*Avicennia alba*	1st ,,
		+	2	*Aeluropus repens*	1st ,,
,,	,,	4	4	*Sesuvium portulacastrum*	2nd ,,
,,	,,	+	1	*Avicennia alba*	,, ,,
,,	,,	+	1	*Aeluropus repens*	,, ,,
,,	,,	3	3	*Sesuvium portulacastrum*	1st ,,
,,	,,	+	1	*Avicennia alba*	,, ,,
,,	,,	4	4	*Aeluropus repens*	,, ,,
,,	Towards West.	5	4	*Avicennia alba*	1st ,,
,,	,,	+	1	*Sesuvium portulacastrum*	,, ,,
,,	,,	4	4	*Avicennia alba*	2nd ,,
,,	,,	+	1	*Sesuvium portulacastrum*	,, ,,
,,	,,	4	4	*Avicennia alba*	3rd ,,
,,	,,	+	1	*Sesuvium portulacastrum*	,, ,,
,,	,,		3	*Avicennia alba*	4th ,,
,,	,,	+	1	*Sesuvium portulacastrum*	,, ,,
,,	,,	5	4	*Avicennia alba*	5th ,,
,,	,,	+	1	*Sesuvium portulacastrum*	,, ,,

Note.—On 24-4-39 and 5-5-39 the following plants along Mahim-Bandra, railway lines (on both sides) between Mahim and Bandra, were in flowering and fruiting stage.

TABLE 2—*(contd.)*

Analytical characters of Marshy Vegetation of Mahim—*(contd.)*

Date	Place	Dominance	Sociability	Plant	Remarks
				Acanthus ilicifolius	In fls & fts.
				Rhizophora mucronata	,, ,,
				Suaeda fruticosa	,, ,,
				Sonneratia apetala	,, only.
				Ceriops candolleana	,, ,,
				Sesuvium portulacastrum	,, ,,
				Clerodendron inerme	only in fts.
				Aeluropus repens	,, ,,
				Bruguiera parviflora	,, ,,
				Avicennia officinalis	In fls. & fts.
				Avicennia alba	Not in fls.

TABLE 3

Analytical characters of Marshy Vegetation of Diva.

10 × 10 Meters Quadrat.

Date	Place	Dominance	Sociability	Plant	Remarks
19-9-38	Diva near the creek north east.	3	1	*Fimbristylis ferruginea*	*Sporobolus glaucifolius* vegetation.
		4	4	*Sporobolus glaucifolius*	1st Quadrat.
	,,	1	2	*Acanthus ilicifolius*	In fls. and fts.
	,,	+	1	*Aeluropus repens*	2nd Qdt.
	,,	+	+	*Ceriops candolleana*	3rd Qdt.
	,,	+	+	*Sonneratia apetala*	In fts. Fs. fallen down.
	Still further along the Creek.	2	4	*Cyperaceae*	4th Qdt.
		2	3	*Paspalum vaginatum*	
	,,	4	4	*Aeluropus repens*	On drier land near Ry. lines 5th Qdt.
	,,	3	4	*Avicennia alba.*	,, ,, ,,
2-5-39	Diva-Mumbra Creek, west to south-west.	4	4	*Acanthus ilicifolius*	1st Qdt. In fls, and fts.
		+	1	*Aeluropus repens*	
		4	4	*Acanthus ilicifolius*	2nd Qdt. In fls. and fts.
	,,	+	+	*Aeluropus repens*	
	,,	4	5	*Acanthus ilicifolius*	In fls. and fts 3rd Qdt.
	,,	+	+	*Aeluropus repens*	
	,,	4	3	*Acanthus ilicifolius*	In fls. and fts. 4th Qdt.
	,,	+	1	*Aeluropus repens.*	

TABLE 3—(*contd.*)

Analytical characters of Marshy Vegetation of Diva
10 × 10 Meters Quadrat—(*contd.*)

Date	Place	Dominance	Sociability	Plant	Remarks
2-5-39	Towards south-east.	4	4	*Acanthus ilicifolius*	In fls. and fts.
		+	1	*Avicennia alba*	5th Qdt.
		+	+	*Aeluropus repens.*	
	,,	4	3	*Acanthus ilicifolius*	In fls. and fts.
	,,	1	1	*Avicennia alba*	6th Qdt.
	..	+	+	*Aeluropus repens*	
21-5-39	Diva Mumbra. Creek North-east.	3	3	*Sonneratia apetala*	1st Qdt. in fls. and mainly fts.
		3	4	*Acanthus ilicifolius*	fls. and fts.
		1	2	*Aeluropus repens.*	
	,,	3	3	*Sonneratia apetala*	In fls. and fts.
	,,	4	3	*Acanthus ilicifolius*	2nd Qdt.
21-5-39	Diva Mumbra Creek, North-east.	+	1	*Sonneratia apetala*	In fls. and fts.
		3	3	*Acanthus ilicifolius*	,, ,, 3rd Qdt.
,,	,,	1	1	*Sonneratia apetala*	In fls. and fts.
,,	,,	3	3	*Acanthus ilicifolus*	,, ,,
,,	,,	1	2	*Aeluropus repens*	4th Qdt.
,,	,,	1	1	*Sonneratia apetala*	In fls. and fts.
,,	,,	3	3	*Acanthus ilicifolius*	,, ,,
,,	,,	1	2	*Aeluropus repens*	5th Qdt.
,,	,,	+	1	*Sonneratia apetala*	In fls. and fts.
,,	,,	3	4	*Acanthus ilicifolius*	,, ,,
,,	,,	1	1	*Aeluropus repens*	6th Qdt.
,,	,,	+	1	*Sonneratia apetala*	In fls. and fts.
,,	,,	3	3	*Acanthus ilicifolius*	,, ,,
,,	,,	1	2	*Aeluropus repens*	7th Qdt.
,,	,,	+	1	*Sonneratia apetala*	In fls. and fts.
,,	,,	3	3	*Acanthus ilicifolius*	,, ,,
,,	,,	1	2	*Aeluropus repens*	8th Qdt.
,,	,,	1	1	*Sonneratia apetala*	In fls. and fts.
,,	,,	4	3	*Acanthus ilicifolius*	9th Qdt. ,, ,,
,,	,,	1	1	*Sonneratia apetala*	10th Qdt. both
,,	,,	3	3	*Acanthus ilicifolius*	In fls. and fts.
,,	,,	4	3	*Acanthus ilicifolius*	In fls. and and fts.
,,	,,	1	1	*Aeluropus repens*	11th Qdt.
,,	,,	4	4	*Acanthus ilicifolius*	In fis. and fts.
,,	,,	1	2	*Aeluropus repens*	12th Qdt.
,,	,,	3	4	*Acanthus ilicifolius*	In fls. and fts.
,,	,,	1	1	*Aeluropus repens*	13th Qdt
,,	,,	3	4	*Acanthus ilicifolius*	In fls. and fts.
,,	,,	3	3		14th Qdt.
,,	,,	3	4	,, ,,	15th Qdt. ,,
,,	,,	3	3	,, ,,	16th ,, ,,
,,	North West.	4	3	,, ,,	17th ,, ,,
,,	,,	4	3	,, ,,	18th ,, ,,
,,	,,	4	3	,, ,,	19th ,, ,,
,,	,,	+	1	,, ,, *Aeluropus repens*	20th ,, ,,
,,	,,.	+	+	*Avicennia alba*	

TABLE 4

Analytical characters of Marshy Vegetation of Bhandup-Vikhroli.

Date	Place	Dominance	Sociability	Plant	Remarks
19–5–38	Kurla to Ghatkopar along Rly. After the Station			*Aeluropus repens*	In patches or drier soil.
		1	1	*Avicennia alba*	1st Qdt.
	,,	2	2	*Aeluropus repens*	On dry soil.
2–5–39	Near Ghatkoper.	3	3	*Avicennia alba*	1st Qdt.
		1	1	*Aeluropus repens*	,,
,,	Still further along Rly. lines.	3	3	*Avicennia alba*	2nd Qdt.
		2	1	*Aeluropus repens*	,,
,,	,,	3	2	*Avicennia alba*	3rd Qdt.
		2	2	*Aeluropus repens*	,,
,,	,,	3	2	*Avicennia alba*	4th Qdt.
		2	1	*Aeluropus repens*	,,
2–5–39	Vikhroli, East and N. East.	3	3	*Avicennia alba*	1st Qdt.
		2	3	*Aeluropus repens*	,,
,,	,,	3	3	*Avicennia alba*	1st Qdt.
		2	1	*Aeluropus repens*	,,
19–5–38	Further upto Vikhroli St.	2	3	*Avicennia alba*	2nd Qdt.
		2	2	*Aeluropus repens*	,, On dry soil.
2–5–39	Further upto Bhandup.	2	3	*Avicennia alba*	3rd Qdt. ,,
		3	3	*Aeluropus repens*	,, ,,
,,	,,	1	2	*Avicennia alba*	4th Qdt. ,,
		3	3	*Aeluropus repens*	,, ,,
,,	Bhandup, North-East.	3	2	*Avicennia alba*	1st Qdt.
		+	1	*Aeluropus repens*	,,
,,	,,	2	3	*Avicennia alba*	2nd Qdt.
		+	+	*Aeluropus repens*	,,
,,	,,	3	3	*Avicennia alba*	3rd Qdt.
		+	1	*Aeluropus repens*	,,

TABLE 5

Analytical characters of Marshy Vegetation of Vadala.

Date	Place	Dominance	Sociability	Plant	Remarks
23-11-38	Siwri, near fish wharf.	2	11	*Avicennia alba*	1st Qdt.
		1	1	,, ,,	2nd ,,
10-12-38	,,	2	1	,, ,,	1st ,,
		+	1	,, ,,	2nd ,,
	Siwri dock in Kolivada. On dry soil	2	2	*Avicennia alba*	1st ,,
		+	1	*Aeluropus repens*	,, ,,
12-8-37	Vadala salt pan area.	4	3	*Sesuvium portulacastrum*	1st Qdt. fls.
		2	2	*Aeluropus repens*	,, ,,
		1	1	*Suaeda fruticosa*	,, ,,
					Suaeda almost disappearing.
23-11-38	,,	3	3	*Aeluropus repens*	1st Qdt. Fts.
	,,	2	2	*Sesuvium portulacastrum*	,,
		+	1	*Salvadora persica*	,,
		1	1	*Clerodendrum inerme*	,,
10-5-39	Vadala shore from Siwri to the Creek	4	5	*Avicennia alba*	1st Qdt. In pure population.
,,	,,	4	5	,, ,,	2nd Qdt. ,,
,,	,,	5	5	,, ,,	3rd ,, ,,
,,	,,	4	5	,, ,,	4th ,, ,,
,,	,,	5	5	,, ,,	5th ,, ,,
,,	,,	3	5	,, ,,	6th ,, ,,
,,	,,	4	5	,, ,,	7th ,, ,,
,,	,,	4	5	,, ,,	8th ,, ,,
,,	,,	3	5	,, ,,	9th ,, ,,
,,	,,	5	5	,, ,,	10th ,, ,,
	Along Port Trust Ry. to the bridge				*Aeluropus repens* in patches on drier soil. *Clerodendrum inerme* on the bunds.
,,	Near the P. T. Ry. bridge on both sides	3	3	*Avicennia alba*	1st Qdt.
,,	,,	2	2	,, *officinalis*	,,
,,	,,	3	4	*Avicennia alba*	2nd Qdt.
,,	,,	3	3	,, *officinalis*	,,
,,	,,	4	3	*Avicennia alba*	3rd Qdt.
,,	,,	3	3	,, *officinalis*	,,
,,	,,	4	3	*Avicennia alba*	4th Qdt.
,,	Still further along the Ry. lines upto the bifurcation of Oil Pipe line.	3	4	,, *officinalis*	,,
		3	3	*Avicennia alba*	1st Qdt. with bushes of *A. repens*
		3	3	,,	2nd ,,
		3	3	,,	3rd ,,

TABLE 5—(*contd.*)

Analytical characters of Marshy Vegetation of Vadala—(*contd.*)

Date	Place	Dominance	Sociability	Plant	Remarks.
10-3-39	Along the Pipe line and south of Mahul coast	4	3	*Avicennia alba*	1st Qdt.
,,	,,	3	3	,, ,,	2nd Qdt.
,,	,,	4	4	,, ,,	3rd ,,
,,	,,	4	5	,, ,,	4th ,,
,,	,,	4	3	,, ,,	5th ,,
,,	On the opp. side of the Pipe line upto Pir Pau's tomb.	3	3	,, ,,	1st ,,
,,	,,	3	2	,, ,,	2nd Qdt.
,,	,,	3	2	,, ,,	3rd ,,
,,	On the North Ry. lines along the creek	3	2	,, ,,	1st Qdt. With
,,	,,	3	3	,, ,,	2nd ,, *A.*
,,	,,	3	2	,, ,,	3rd ,, *repens*
,,	Along the S. Tram line upto Kurla.				Very few bushes
,,	Near Kurla St.	2	2	,, ,,	1st Qdt.

TABLE 6

Analytical characters of Marshy Vegetation of Sion-Dharavi-Agra Road

Date	Place	Dominance	Sociability	Plant	Remarks
21-11-38	Mahim to Sion Via Dharavi Rd.			Along the road throughout, on the drier soil patches of *Aeluropus repens* (in fls); near Municipal drainage work *Avicennia alba* and *A. officinalis* and a patch of *Acanthus ilicifolius* near Sion, are found.	
,,	Near Sion Stn.	3	3	*Acanthus ilicifolius*	1st Qdt.
,,	on both sides	3	2	,, ,,	2nd ,,
	of the creek.	1	1	*Avicennia alba*	,, ,,
,,	Further to-	2	2	,, ,,	3rd Qdt.
	wards Kurla.	3	2	*Acanthus ilicifolius*	,, ,,
	Near Kurla on	3	3	*Avicennia alba*	4th Qdt.
	opp. bank of	2	1	*Acanthus ilicifolius*	,, ,,
	the creek.				

TABLE 6—(*contd.*)

Analytical characters of Marshy Vegetation of Sion-Dharavi-Agra Road

Date	Place	Dominance	Sociability	Plant	Remarks
18-5-39	Near Sion St. along Agra Rd.	5	5	*Acanthus ilicifolius*	1st Qdt. In fls. & fts.
		2	4	*Avicennia alba*	
,,	,,	4	4	*Acanthus ilicifolius*	2nd Qdt. ,,
		4	4	*Avicennia alba*	,, ,, ,,
,,	,,	3	3	*Acanthus ilicifolius*	3rd Qdt. ,,
		3	3	*Avicennia alba*	,, ,, ,,
,,	,,	3	3	*Acanthus ilicifolius*	4th Qdt. ,,
		1	1	*Avicennia alba*	,, ,, ,,
18-5-39	On the opp. bank of the creek.	4	3	*Acanthus ilicifolius*	1st Qdt. in fls. & fts.
,,	,,	3	3	*Avicennia alba*	,, ,, ,,
		+	1	*Rhizophora mucronata*	,, ,, ,,
,,	,,	3	3	*Acanthus ilicifolius*	2nd Qdt. ,,
		3	3	*Avicennia alba*	,, ,, ,,
,,	,,	3	3	,, ,,	3rd Qdt. ,,
		2	3	*Acanthus ilicifolius*	,, ,, ,,
,,	,,	3	3	,, ,,	4th ,, ,,
		3	2	*Avicennia alba*	,, ,, ,,
,,	,,	3	3	,, ,,	5th ,, ,,
		3	2	*Acanthus ilicifolius*	,, ,, ,,
		3	2	*Aeluropus repens*	,, ,, ,,
,,	,,	4	3	*Avicennia alba*	6th ,, ,,
		2	2	*Acanthus ilicifolius*	,, ,, ,,
		2	3	*Aeluropus repens*	,, ,, ,,
,,	,,	5	4	*Avicennia alba*	7th Qdt. ,,
		1	2	*Acanthus ilicifolius*	,, ,, ,,
		3	3	*Aeluropus repens*	,, ,, ,,
,,	,,	4	4	*Avicennia alba*	8th Qdt. ,,
		1	1	*Acanthus ilicifolius*	,, ,, ,,
		3	3	*Aeluropus repens*	,, ,, ,,
,,	,,	1	1	*Avicennia alba*	9th Qdt. ,,
		2	2	*Acanthus ilicifolius*	,, ,, ,,

TABLE 7

Analytical characters of Marshy Vegetation of Thana

Date	Place	Dominance	Sociability	Plant	Remarks
26-5-38	Thana, along the Rly. line near the creek	4	5	*Avicennia alba*	1st Qdt.
		3	2	*Acanthus ilicifolius*	,, ,,
		+	1	*Sporobolus glaucifolius*	,, ,,
		+	2	*Aeluropus repens*	,, ,,
,,	,,	4	5	*Avicennia alba*	2nd Qdt.
		+	2	*Acanthus ilicifolius*	,, ,,
		+	2	*Aeluropus repens*	,, ,,

TABLE 6—(*contd.*)

Analytical characters of Marshy Vegetation of Sion-Dharavi-Agra Road

Date	Place	Dominance	Sociability	Plant	Remarks
18-5-39	Near Sion St. along Agra Rd.	5	5	*Acanthus ilicifolius*	1st Qdt. In fls. & fts.
		2	4	*Avicennia alba*	
,,	,,	4	4	*Acanthus ilicifolius*	2nd Qdt. ,,
		4	4	*Avicennia alba*	,, ,, ,,
,,	,,	3	3	*Acanthus ilicifolius*	3rd Qdt. ,,
		3	3	*Avicennia alba*	,, ,, ,,
,,	,,	3	3	*Acanthus ilicifolius*	4th Qdt. ,,
		1	1	*Avicennia alba*	,, ,, ,,
18-5-39	On the opp. bank of the creek.	4	3	*Acanthus ilicifolius*	1st Qdt. in fls. & fts.
,,	,,	3	3	*Avicennia alba*	,, ,, ,,
		+	1	*Rhizophora mucronata*	,, ,, ,,
,,	,,	3	3	*Acanthus ilicifolius*	2nd Qdt. ,,
		3	3	*Avicennia alba*	,, ,, ,,
,,	,,	3	3	,, ,,	3rd Qdt. ,,
		2	3	*Acanthus ilicifolius*	,, ,, ,,
,,	,,	3	3	,, ,,	4th ,, ,,
		3	2	*Avicennia alba*	,, ,, ,,
,,	,,	3	3	,, ,,	5th ,, ,,
		3	2	*Acanthus ilicifolius*	,, ,, ,,
		3	2	*Aeluropus repens*	,, ,, ,,
,,	,,	4	3	*Avicennia alba*	6th ,, ,,
		2	2	*Acanthus ilicifolius*	,, ,, ,,
		2	3	*Aeluropus repens*	,, ,, ,,
,,	,,	5	4	*Avicennia alba*	7th Qdt, ,,
		1	2	*Acanthus ilicifolius*	,, ,, ,,
		3	3	*Aeluropus repens*	,, ,, ,,
,,	,,	4	4	*Avicennia alba*	8th Qdt. ,,
		1	1	*Acanthus ilicifolius*	,, ,, ,,
		3	3	*Aeluropus repens*	,, ,, ,,
,,	,,	1	1	*Avicennia alba*	9th Qdt. ,,
		2	2	*Acanthus ilicifolius*	,, ,, ,,

TABLE 7

Analytical characters of Marshy Vegetation of Thana

Date	Place	Dominance	Sociability	Plant	Remarks
26-5-38	Thana, along the Rly. line near the creek	4	5	*Avicennia alba*	1st Qdt.
		3	2	*Acanthus ilicifolius*	,, ,,
		+	1	*Sporobolus glaucifolius*	,, ,,
		+	2	*Aeluropus repens*	,, ,,
,,	,,	4	5	*Avicennia alba*	2nd Qdt.
		+	2	*Acanthus ilicifolius*	,, ,,
		+	2	*Aeluropus repens*	,, ,,

TABLE 7—(*contd.*)

Analytical characters of Marshy Vegetation of Thana—(*contd.*)

Date	Place	Dominance	Sociability	Plant	Remarks
26-5-38	Thana, along the Rly. line near the creek	5	5	*Aeluropus repens*	3rd Qdt.
		+	1	*Avicennia alba*	,, ,,
,,	Near the creek shore	2	3	*Sesuvium portulacastrum*	4th Qdt.
		+	2	*Salvadora persica*	,, ,,
27-11-38	On sides of the Vehicle & Rly. bridges	3	3	*Avicennia alba*	1st Qdt.
		2	3	*Acanthus ilicifolius*	,, ,,
,,	,,	3	3	*Avicennia alba*	2nd Qdt.
		2	2	*Acanthus ilicifolius*	,, ,,
,,	Between the two Bridges	4	3	*Avicennia alba*	1st Qdt.
		3	3	*Acanthus ilicifolius*	,, ,,
,,	South of the Rly. Bridge	3	4	*Avicennia alba*	2nd Qdt.
		1	2	*Acanthus ilicifolius*	,, ,,
		+	1	*Aeluropus repens*	,, ,,

TABLE 8

Analytical characters of Marshy Vegetation of Colaba.

Date	Place	Dominance	Sociability	Plant	Remarks
18-1-39	Colaba Reclamation area.	4	4	*Avicennia alba* }	1st. Qdt.
,,	,,	+	1	*Avicennia officinalis* }	
,,	,,	4	4	*Avicennia alba* }	2nd Qdt.
,,	,,	+	1	*Avicennia officinalis* }	
2-3-39	Towards near barracks.	3	3	*Avicennia alba*	3rd Qdt.
,,	,,	3	2	*Avicennia alba*	4th Qdt.

TABLE 9

Analytical characters of Marshy Vegetation of Ghod Bundar.

Date	Place	Dominance	Sociability	Plant	Remarks
4-12-38 „	Mira Rd. Stn. South-west.	2	3	*Avicennia alba*	1st Qdt.
„	Dinanath Khar Farm Area. South-east.	2	3	*Avicennia alba*	2nd Qdt.
		1	2	*Acanthus ilicifolius*	„ „
		+	2	*Ceriops candolleana*	„ „
		+	1	*Bruguiera gymnorhiza*	„ „
		+	1	*Salvadora persica*	„ „
		+	1	*Rhizophora mucronata*	„ „
„	„ „	2	3	*Aeluropus repens*	3rd Qdt.
„	„ „	1	2	*Suaeda fruticosa*	„ „
		1	3	*Clerodendrum inerme*	„ „
27-4-37	Ghod Bundar.	3	4	*Avicennia officinalis*	1st Qdt.
		2	3	*Acnnthus ilicifolius*	„ „
18-12-38	„ „	4	4	*Avicennia alba*	2nd Qdt.
		2	3	*Acanthus ilicifolins*	„ „
„	Near the temple Tank.	3	4	*Sonneratia apetala*	3rd Qdt.
		2	3	*Aegiceras majus*	„ „
		1	2	*Bruguiera gymnorhiza*	„ „
„	Towards Gaimukh Bandar.	3	3	*Rhizophora mucronata*	4th Qdt.
		2	3	*Ceriops candolleana*	„ „
„	„	3	5	*Avicennia alba*	5th Qdt.
		2	3	*Acanthus ilicifolius*	„ „
„	„	4	4	*Avicennia alba*	6th Qdt.
		1	3	„ *officinalis*	„ „
„	„	2	3	*Rhizophora mucronata*	7th Qdt.
		3	3	*Ceriops candolleana*	„ „
		2	3	*Bruguiera gymnorhiza*	„ „
„	„	4	4	*Avicennia alba*	8th Qdt
		2	3	*Aegiceras majus*	„ „
		2	3	*Acanthus ilicifolius*	„ „
„	Near Gaimukh Bandar	4	5	*Avicennia alba*	9th Qdt.
		2	3	„ *officinalis*	„ „
		2	2	*Bruguiera gymnorhiza*	„ „
„	„	4	5	*Avicennia alba*	10th Qdt.
		3	3	„ *officinalis*	„ „
		2	2	*Acanthus ilicifolius*	„ „
		2	3	*Ceriops candolleana*	„ „
		+	1	*Kandelia rheedii*	„ „

TABLE 10

Analytical characters of Marshy Vegetation of Elephanta Island

Date	Place	Dominance	Sociability	Plant	Remarks
16-5-37	Elephanta East	4	4	*Sonneratia acida*	1st Qdt.
,,	,,	3	4	,, ,,	2nd ,,
,,	,,	3	5	,, ,,	3rd ,,
,,	,,	4	5	,, ,,	4th ,,
16-5-37	Elephanta East	4	3	*Avicennia alba*	In front of *Sonneratia.* ,, 1st Qdt.
,,	,,	3	5	,, ,,	,, 2nd ,,
,,	,,	3	5	,, ,,	,, 3rd ,,
,,	,,	3	4	*Aeluropus repens*	1st Qdt.
,,	,,	2	4	,, ,,	2nd ,,
,,	,,	1	3	*Avicennia alba*	,, ,,
,,	Near Shet Bandar	3	4	*Sonneratia acida*	1st Qdt.
,,		4	4	,, ,,	2nd ,,
		4	3	,, ,,	3rd ,,
,,	,,	2	3	*Avicennia alba*	,, ,,
5-5-37	Mora, via Uran	3	5	*Avicennia alba*	1st Qdt.
		2	4	*Sonneratia acida*	,, , 2 in fts.
,,	,,	3	4	*Avicennia alba*	2nd Qdt.
		1	3	*Sonneratia acida*	,, ,,
,,	Panje, island	3	4	*Avicennia officinalis*	1st Qdt.
		3	4	*Aeluropus repens*	,, ,,
		+	2	*Sonneratia acida*	,, ,,
,,	Dongri, island	+	2	*Avicennia officinalis*	1st Qdt.
,,	,, ,,	+	1	,, ,,	2nd ,,

TABLE 11

Analytical characters of Marshy Vegetation of Trombay Island

Date	Place	Dominance	Sociability	Plant	Remarks
25-9-38	Kurla to Trombay, near Chembur, along the Rly. line	2	3	*Avicennia alba*	1st Qdt.
		1	2	,, ,,	,, ,,
,,	East of the Trombay Hill near the shore	2	2	,, ,,	1st Qdt.
		3	2	,, ,,	2nd ,,
		2	3	,, ,,	3rd ,,

TABLE 12

Analytical characters of Marshy Vegetation of Madh Island

Date	Place	Dominance	Sociability	Plant	Remarks
27-4-37	Madh Island Eastern side	3	3	*Avicennia alba*	1st Qdt trees
,,	,,	2	3	,, ,,	2nd ,, ,,

MORE NOTES ON BIRDS OF THE GANDAK-KOSI WATERSHED, NEPAL[1]

BY

DESIRÉE PROUD

This year we again had the chance of a short holiday on the ridge leading to the Gosainkund Lekh. We chose the first half of May as the weather is usually settled in Nepal at that time of year, and we hoped that the birds would be breeding in the higher hills. As far as the birds were concerned the trip was very successful, but the weather could hardly have been worse. There was a thunder-storm every evening, and above 9,000 ft. a thick mist from about 9 a.m. onwards. The early mornings were usually fine, and the views of course all the more perfect after the rain. We made a small collection of birds and plants, and these have been identified in the Natural History Museum in London. As I am no botanist I have put a query after the names of plants identified only by me, and not in the Museum.

May 5th: With what joy does one leave the valley for a fortnight in the high hills. I know of no greater pleasure. Left Sandarigal at 11 a.m. Hot, but a faint breeze blowing. *Symplocos crataegoides* in flower all along the path, small trees, very like the English hawthorn and with the same strange perfume, the 'deathly' perfume of the poet—

> 'The flowers of the field have a sweet smell,
> Meadowsweet, tansy, thyme and faint-heart pimpernel,
> But sweeter even than these
> The silver of the May
> Wreathed is with incense
> For the Judgement day.'

The hum of bees surrounds every tree. Plumbeous Redstarts were feeding young still in the nest. Two and a half hours to the top of the ridge, 8,000 ft. No bird song in these sultry midday hours, except from the Greyheaded Flycatcher-Warbler which is never silent, and occasional sweet notes from the Whistling Thrushes near the stream. On this ridge the hawthorn-like *Symplocos* does not grow above 7,000 ft. (I have seen it much higher elsewhere) and its place is taken by *S. sumantia*. This flowers in March, and nothing now left but bunches of dried brown stamens. *Quercus lamellosa* (?) that loveliest of the Himalayan oaks, now quite bare of leaves, but the fat lilac-coloured buds lifted against the blue sky. It is only bare of leaves for a very short time. Over the ridge we searched for a camp site in the lovely little valleys full of flowering berberis (*B. aristata* ?) and viburnum (*V. erubescens*). The best sites had no water, and when water was found the land was steep and exposed to the wind. There is much to be said in these steep hills for small bivouac tents and no camp beds. A larger tent could not have been pitched here, but two small shelves were soon found into which bedding rolls fitted very comfortably. A roaring wind was blowing from the west. All the storms seem to come from there. I suppose they start in the hot Trisuli Valley. By 6.30 we had finished supper and all the kit safely stowed under tarpaulins. Soon fell asleep, but awoke boiling hot at 10.30 the wind having dropped. Hastily unlaced the tent and looked out into a magical world flooded with moonlight. Utter peace and stillness, broken only by Richard snoring happily from the other tent.

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[1] For the first article 'Some Birds seen on the Gandak-Kosi Watershed in March, 1951' see *J.B.N.H.S.*, **50** (2): 355-366 (December, 1951).

May 6th: Woke at 5 a.m. to a grey wet dawn. The little owl (*Otus*) calling *phew phew*, a cuckoo cuckooing. A wild call rather reminiscent of a wader, may perhaps have been the Hill Partridge, but I never found out for certain. Scimitar Babblers and Stripe-throated Yuhinas calling softly in the berberis bushes. A pair of stonechats had a nest near by. Breakfast finished, gear packed and away by 8. Walked down the hill in a cold wind and light drizzle, very unusual for the time of year. The grass covered with blue gentians and yellow dandelions. We reached Pati Bhanjyang at 9.30, and sat outside the village while the coolies bargained for food; we were not going to repeat the mistake of last year when we had gone on without them, only to wait for hours on the hills beyond. Nepal Martins were hawking back and forth across the ridge in company with Redrumped Swallows. The latter had nests within the little houses, but I have never discovered where the martins breed; they are great wanderers and are seldom seen in these hills. A cuckoo perched on a bare tree above our heads was uttering the most extraordinary grunting noises. I thought it was perhaps the 'curse' of the Eastern Cuckoo, but it presently began the familiar *ek hud hud hud* of the Himalayan Cuckoo. The first note can only be heard at very close quarters. The call repeated about 27 times a minute. Do most cuckoos perhaps utter a 'curse' occasionally as well as their more usual notes? Drongo Cuckoos were also calling, and the *see saw* of the hill warbler heard everywhere. *Gaultheria* in flower, and a bush with very beautiful blue flowers and white buds was coming into bloom (*Hamiltonia suaveolens*). *Pieris ovalifolia* had everywhere finished flowering and was covered with young leaves very fresh and green; it is a beautiful tree at all seasons. A kite flew overhead, the only one seen. The climb from Pati Bhanjyang is the most unpleasant in the whole trip, and though we were lucky in having it comparatively cool, it was with relief that, sweating and dusty, we finally reached the village and its terraced fields. The village as dirty as ever, the last of the oaks destroyed, but the little fields very neat, full of maize and potatoes. Tragic though it is to see the forest destroyed, one can not help admiring the loving care and endless labour which these people give to their land. At 7,500 ft. the forest starts again, a sadly thinned forest, but swarming with birds. Here we heard again the hawk-cuckoo, maddening bird, always keeping just out of sight, his identity still a mystery to us. We camped as usual on the flat top of a hill on the Mamche Danda.

Hardly into our beds when a terrific storm burst upon us; drenching rain and a roaring wind. I was afraid the tents would blow away and hung on to the tent pole which showed an unpleasant inclination to jump off the ground. After an hour it died away and I fell asleep to a mere gentle pattering on the canvas.

May 7th: Woke to a glorious day. Every high hill shining with fresh snow. The hawk-cuckoo was the first to call followed by the Indian, Eastern, and Himalayan Cuckoos in that order. The Himalayan is always a very late riser and never calls at night as many of the others do. Greywinged Blackbirds and Verditer Flycatchers singing, and the lovely whistle of the Wedgetailed Green Pigeon rippled up from the hillside below where 5 or 6 of them were perched in the tops of the lopped and tortured oaks. A Himalayan Nuthatch was carrying food into a nest hole about 40 ft. from the ground. The Orangebarred Willow-Warblers, so common here in March, had all moved on. Himalayan Swiftlets were hawking above the camp. *Pieris formosa* had finished flowering but was covered with young red leaves forming patches of vivid colour round the camp. We did not hurry away but let our tents dry in the brilliant sunshine, having decided to do only a very short march to-day. It is a pleasant walk down to Gol Bhanjyang. Upland Pipits calling and a pair of Serpent Eagles soaring overhead. A shrub (a *Symplocos* I think, but not *sumantia* or *crataegoides*) was everywhere in bud. We never found any opened flowers and did not succeed in identifying it. As we climbed the steep hill above the saddle I heard for the first time the sweet high-pitched song of the Bluechat. Dr. Dillon Ripley has found this bird in breeding condition in the Nepal valley. I do not think any of them actually remain to breed in the valley, except perhaps 1 or 2 pairs on top of Sheopuri or Phulchok. We always hear it on passage for a short time in March and early April, but it soon passes on and after that I have only found it on these inner hills and above 8,000 ft. At the top of the hill we entered our rhododendron forest—alas, a sadly changed place from the enchanted world of March last year. The flowers were all over and the forest dark, damp and uninviting. However, as the storm clouds were already hanging over the hills ahead we decided to camp, and pitched the tents in a little green valley. *Quercus semecarpifolia*, *Rhododendron arboreum* and *Pieris ovalifolia* the chief trees, *Berberis* and *Viburnum* both in flower formed the undergrowth and the ground was carpeted with yellow oxalis and strawberries both in flower and fruit. This ridge is a very interesting one, as it forms a bridge between the lower and higher hills. Although the same elevation (8,000) as the Mamche Danda and Sheopuri, and though the bird and plant life is on the whole the same as found on these two ridges, there are quite a number of species found here which are never seen on the other two (except of course during winter in the case of the birds). These include the Orangebarred Willow-Warbler, the Orangebreasted Flycatcher, the Redflanked Bush-Robin, *Yuhinia occipitalis*, Darkgrey Bushchat, Blackbrowed Flycatcher-Warbler and Bluechat, plants from the higher hills seen here for the first time were *Prunus cornuta*, *Anemone obtusiloba* (?), and a little trailing white raspberry (*Rubus calycinus*). There were a few yew trees, but these are also found on Sheopuri though nowhere else round the valley. This is also the last ridge where many of the common birds of the lower hills are found, such as Greenbacked and Redheaded Tits, Longtailed Minivets, Verditer and Greyheaded Flycatchers, and Rufouscollared Yuhinas. Whitethroated Laughing-thrushes and Barwings are also very common here, and so is the quaint little tit, *Sylviparus modestus*. The yellow eyebrow of this last is quite impossible to see in the field. We had an early supper and were in bed by 7 p.m. expecting the usual storm but not much worried by it, as we were sheltered from the wind, and though I was not quite happy about the site of my tent in a little valley, there was a path running beside it which we thought would be sufficient to carry off any rain water. By 7.30 the rain started, this soon changed to hail which pelted down on the tent with a roar which quite drowned the occasional boom of thunder. Last night I had feared the tent might be blown away, tonight I felt it must surely be torn to ribbons. Flashing on my torch I saw a little flood about 2 inches deep flowing gently in through the top end of the tent. Pulling up the ground sheet round my bedding to make a sort of island I wondered for a brief moment if camping really was such a good idea. Luckily the storm died down for a few minutes and I shouted to poor Richard for help. He rushed out minus all clothing and dug trenches furiously. Slowly the water subsided and Richard regained his tent, only just in time for the hail came roaring down again with redoubled violence. By 10 p.m. it had ceased, and peeping out I saw a white world, the hail stones gathered into drifts inches deep and shining like snow in the faint moonlight. Fell asleep only to be woken in the small hours by a peculiar noise just outside the tent. Again I flashed my torch. A large vague shape blundered noisily away. Only a chumry I realised with relief, but though gentle creatures, they are rather large, and the tent very small. I would just as soon they did not walk on us.

May 8th: Woke at 5 to hear the skinner blowing away at the fire and the cuckoo calling. Richard said he had heard the Indian Cuckoo as early as 2 a.m. Blackbirds singing gloriously, and the thin *zee zee* of the Yellowbrowed Tit, and the whirring song of the Orangebarred Willow-Warbler ringing through the wet woods. The morning was clear but we were in shadow from a small hill and everything was soaking wet. We packed as quickly as possible. Two Sherpa boys watching a herd of chumries came and squatted at the side of the camp. They were soon joined by a girl who had come to fetch water. This she carried in a hollowed-out tree branch suspended by a strap across her forehead. She was very talkative and gay with the natural friendliness of all Sherpas in these hills. She was very interested in our bedding and felt the blankets critically, but they were good ones she said. Our coolies had spent the night in her family hut, one of them, rather a good looking youth was far too busy flirting with her to pay any attention to his share of the packing. However, she administered a resounding slap on the side of his face, to the delight of the others, and looking rather foolish he returned to his work. We were away by 8.30, very pleasant walking up the ridge on the springy green grass. Last year it had all been dusty and dried up, now after the rain it was all fresh and green, the narrow ridge often widening out into enchanting alps. At 9,000 ft. we entered the dark oak forest. Here we heard for the first time the thin trill of the Nepal Tree-creeper, and came upon a pair of the adorable little Yellowbellied Flycatchers, bobbing and pirouetting like the larger fantail flycatchers of the lower hills. From here the Orangebreasted Flycatcher was one of the commonest birds, every little valley or alp holding its pair. They guard their territory jealously. On emerging from the oaks we found the belt of grass, which leads up the hill between the thick rhododendron forest, thickly starred with anemones (*obtusiloba*?) blue and white, also gentians and dandelions and a little white crucifer (*Draba*?). One little dell was absolutely blue with anemones and I was enchanted until I found that it was also swarming with leeches. My enthusiasm greatly damped as I hastened away to drier ground. We had not expected to find them so early in the year and at this height. The unusually heavy rains, I suppose. The rhododendrons, mostly *R. falconeri*, were covered with faded flowers. We were too late for them as we had been too early last year. Up and up the path climbs then winds round the ridge and up a narrow gravel-filled nullah between two hills. This is a good landmark from the south and can be seen from the hills round Kathmandu. It looks very steep but is not so really. Thick mist covered all the higher hills and a cold cold wind blew from the north west, straight from the snows. From the top of the nullah all the ridge to the immediate north is covered with *R. campanulatum*, now in full flower. Nothing this year compares with the beauty of flowering *R. arboreum* last March but *campanulatum* is attractive in flower. The stems grey, varying from silver to almost pink often outlined with black lichen, the leaves rounded at the tip, dark glossy green above, rusty or cream beneath. The flowers mauve, deep purple in bud fading with age. A hillside covered with them has a curiously silver shimmering appearance, perhaps partly from light reflected from the glossy leaves, always now wet from the latest shower. *R. barbatum* was also still in flower and must have a long season as it was in bloom last year in March, when there was no sign of any flowers on other high level rhododendrons. The leguminous shrub *Piptanthes nepalensis* which flowers profusely on Sheopuri in March was a blaze of yellow here now. We decided to camp on our favourite marg with the 4 huts. One of these was soon made comfortable with a thick juniper carpet and the tents tied over the many gaps in roof and walls. Although sheltered from the rain it was now bitterly cold. We put on all our thickest clothes. From midday it rained continuously. In the evening this cleared and a golden sunshine without warmth flooded the world for a few minutes before the sun set. The Gosainkund Lekh as beautiful as ever. After a hot supper we were glad of thick sleeping bags.

May 9th: Woke to a divine morning, but so cold that it was an effort to leave our beds. No cuckoos calling for the first time. The wild song of the Whitecollared Blackbird throbbing in short bursts across the marg. It consists of a few notes or a short phrase repeated usually 4 times then a pause then a fresh phrase again repeated

4 times. This will go on for hours in spite of rain or storms. The song has a magical quality, wild and sweet. It reminds me of the English song thrush in rough spring weather. The graywinged blackbird has a mellow gentle song more like that of the English blackbird. I prefer the thrush, though most English listeners disagree with me, some in fact becoming positively indignant over the matter! The blackbird's song is languid and graceful, the polished product of a court poet, but to me it lacks the magic of the less perfect song, and here particularly the wild notes seem to catch the spirit of the mountains. We stayed 5 nights on this marg. The early hours were always perfect but each day by 10 a.m. the mist had descended and the afternoons were given to rain and storms more or less severe. We were up with the first light and away from camp by 6 a.m. each day. There is so much to explore that a month could profitably be spent here. The bird life very different from that in March last year. The winter migrants have mostly left, though flocks of pipits (both *hodgsoni* and *roseatus*) are common on the marg, and are still on migration I think, presumably for the very high hills, as pairs of both are already established here and breeding. Summer migrants have arrived and are taking up their territories. Rosefinches are abundant, at least 4 species; they are still in flocks, their sweet notes echoing through the forest as they feed in the rhododendrons. Tits are breeding. The Himalayan Cole Tit has a nest in the stone wall of a Sherpa hut. The male (?) sits in a fir tree just above the hut and sings all day endlessly *dir-tee dir-tee dir-tee* his throat and breast puffed out with the effort. The female creeps in and out of the nest hole, quietly and not often. She appears to carry nothing so is apparently incubating. I had intended to collect these tits, but cannot bring myself to shoot them when nesting, a very unscientific attitude I fear!

From this marg a little path leads round the south side of the hills above the Tadi Khola. It has evidently been made by the Sherpas to keep in touch with their various little summer camps. It runs at about 10,400 ft. and does not vary in height more than 100 ft. even when crossing the little valleys. On each ridge is a small camp, usually 2 huts, sometimes 3 or 1 only. At present the walls only, built of stones, for the Sherpas bring the roofs of woven matting with them and use them again and again for each camp. The forest immediately round the camps is usually burnt to give better grazing for the chumries. The Sherpas have not arrived up here yet, though everywhere they are moving up. From the path one looks straight down into the valley of the Tadi Khola and the numerous little tributary valleys. Tiny villages nestle on the flat shelves of land above the river. Cultivation spreads up the sides of the hills above the valleys, sometimes I should think as much as a couple of thousand feet. The valley houses are permanent dwellings with flat wooden roofs of planks kept in place by large stones. One can tell at a glance the difference between Sherpa and Gurkha houses, the latter having the steeply pitched roofs and turned up corners which we see round Kathmandu. Here they are all Sherpas. Above the cultivation comes the zone of lopped *Quercus semecarpifolia* as we have seen it on the way up here, and above this the fir and rhododendron forest. Above each village at a height of about 9,000 ft. is another little settlement, presumably the half way house for spring and autumn. These also have only temporary roofs and are now mostly in occupation. I imagine that each settlement belongs to one family and that they come up year after year, following the tiny precipitous path which leads down each ridge, although they look almost too steep for chumries. I should like to come up later in the year when they are in residence and learn more of the details of their lives. The only people we meet now are woodcutters and these are always Gurkhas (Tamangs) and they do not live up here but come up for a day or two, collect wood and carry it back to Kathmandu. Their methods of wood cutting are wasteful to a degree. Instead of cutting the tree near the root they cut away at anything up to 12 ft. above the ground, the huge stumps being left to rot. They have very inadequate little axes and will chip away at a tree trunk for hours to get one door or plank and then abandon the rest. The hillsides are strewn with wasted wood, a very sad sight. The people themselves are delightful, sometimes we meet whole villages of them who have come up to get shingles (shaklas) for their roofs. They make a picnic of it, and come down singing and laughing, their hair crowned with rhododendrons, women and children as well as men, looking so healthy and happy in spite of their loads of shaklas.

Warm mists rise from the Tadi Khola and we found plants very much more advanced on this path than on the main ridge. Here the lovely yellow rose (*R. serica*) was already in bloom, the long graceful sprays trailing over the hillsides in loops and arches. Anemones blue and white covered the ground as thick as daisies on a May lawn at home. *Pieris formosa*, a common bush up to 10,500 ft. all in vivid young red leaf. In one enchanting gully, overhung by a huge rock, from which water dripped continuously, was a grove of the most beautiful bird cherry trees (*P. cornuta*) all in young leaf, the flowers not yet open. Under these grew a tiny pale primula (*Androsace geraniifolia*), a tiny deep pink primula (*P. listeri*) and several small crucifers (*Sisymbrium* sp ?). Also thickets of a berberis, not very tall with whorls of prickly holly-like leaves and yellow flowers just opening. Gooral kept springing away from us in small groups and I got a beautiful view of one rushing straight down the ridge over the most uncomfortable ground. We also found a small viburnum with white flowers and deeply-veined leaves, very like the English wayfaring tree (*V. cordifolium*). Here the deciduous rhododendron *R. lepidotum* was just opening tiny green leaves, they are still bare on the main ridge. Many banks covered with *Gaultheria nummuleroides* in flower now, the tiny pink and white waxy bells very attractive when examined closely. Chestnutbellied Rock Thrushes were common, each little valley producing its pair. Willow-warblers everywhere. *P. pulcher* abundant and breeding, *P. proregulus* in pairs and keeping to a fixed territory, either a single silver fir or a small group of firs. The other willow-warbler was *P. trochiloides trochiloides*, which was very common from about 10,000 ft. up to 12,000 ft. They were mostly solitary, but 2 specimens obtained were in breeding condition.

May 13th: Even the usual 3 hours of sunshine did not materialise this morning and we set out in a fine rain. Time is running short but the weather not encouraging for the higher hills. Only a short march to Thare Pate but steep in places and I felt sorry for the laden coolies. Above 11,000 ft. *Primula petiolaris* is everywhere in bloom. It has finished flowering in the lower hills, 8,000-9,000 ft. in February, 9,000-10,000 ft. in March and April. The flowers here are rather battered by the storms. Round the Sherpa huts where goats have been tethered grew docks and a purple flower (*Lamium amplexicaule*). A few *Primula denticulata*. Tracks of a panther very clear in the soft path along the ridge at 12,000 ft. Thare Pate looks bleak in the rain and mist, the huts are tumbledown and wet and there is no water near. However we can drink melted snow. There are large rather dirty snow beds on the north slopes, and we set to work with tarpaulins to cover leaks and to spread the juniper over the floor. Incidently no vi-spring mattress can equal the comfort of a deep bed of juniper, and the perfume from the crushed leaves is the best sleeping draught I know. Most of the huts are on the west of the ridge, we chose one just over on the east side as most of the storms and mist comes from the west. We are soon comfortable, but the coolies are very distressed. They have a long hut with no windows and have lighted an enormous fire so that the heat, smoke and fug inside is all that they can desire, but the water is the trouble. They say it does not matter, but they will not eat tonight as too much trouble to melt snow for cooking rice. We tell them to go back to the last camp and to return in 2 days. They depart to discuss this at length. The rain pours down in torrents. However we sit in our hut with a nice scented juniper fire and watch birds. Rosefinches, golden bush robins, redstarts, orangeheaded bulfinches pipits, all within a few feet of the hut. Exquisite firetailed sunbirds flash in and out of the soaking bushes and a female monal walks into the hut and departs noisily on finding it occupied. Monal swarm here and are very noisy and indignant when disturbed. Presently a cooly arrives to say they have found water, and very good water, but a long way down. They bring it back in tins slung between 2 men. They are delighted. At 5 o'clock the rain suddenly clears, clouds lift, golden sunshine floods everything. Jagged rocks and snow peaks appear unexpectedly all round us. Deep valleys on each side of the ridge full of purple shadow, with shreds and tatters of shining mist scattered across them, little bright islands on a dark dark sea. What thrilling country, but bitterly cold. We go early to bed. Shortage of water makes even a pretence of washing mercifully impossible.

May 14th: Up at 5 a.m. Primrose sky and wonderful view. The great peaks of the Jugal Himal brood over us, further to the east is Gauri Shankar. To the west the purple chasm of the Tadi Khola with the jagged Lekh beyond, black against the sky. As the sun rises it catches each ridge in turn and outlines it in gold against the darkness beyond. I now regret time spent on our gentle marg. This is much more thrilling country. Breakfast over, we start off down the pilgrim trail, which is composed mostly of boulders, and winds down a wild weird country. Nullahs full of boulders, covered with lichen; no water, but I suppose that in the monsoon it rushes down the hollow under the rocks. Wrens everywhere; also accentors, Firetailed Sunbirds and Nepal Treecreepers. Numbers of the little warbler *Phylloscopus t. trochiloides*; they sing *siper siper siper*. We leave the bare hill-side and go down a narrow gully into forest of silver fir, birch, juniper, rhododendron, the last a new one with brilliant pink flowers. Brilliant grosbeaks in bare birch. Nutcrackers scream and scold. Suddenly something green and crimson ahead of us. Blood pheasants, the first I have ever seen, what wonderful creatures! At the lowest point of the path, 11,300 feet we cross a little bubbling stream the first water we have seen since our far away marg. The path winds round the hill-side through bamboo. Suddenly a large flock of tiny birds creeping through this; they look like bearded tits—Fulvousfronted Suthoras. Dick shoots 3. They have curious little monkey-like faces. Now the path climbs again, sometimes through thick forest, sometimes over bare hill-side. Here the forest is quite unspoilt, no burning, cutting or lopping. A leafless viburnum with pale pink scented flowers grew along the path (*V. nervosum*). Alas all too soon the mist comes down again, and the blotting rain. We pass a large cave and a swift darts out like an arrow. We reach a little group of pilgrim huts, the view must be wonderful from here, but we can see nothing. Useless to go on. We return regretfully. Rain, hail and tearing wind for the rest of the day, and this time no break at sunset.

May 16th: A wonderful morning. Dick says that he will have a shot at getting to the top of the pass and starts off at dawn. I know that I can't make the pass and get back in one day, but it is with bitter regret that I look across that great valley to the path curling over the hills so deceptively near in this clear light. Richard started at 6.20 and had finished the traverse and started the real climb by 9.30. He got up to 14,300, when he felt exhausted and sick and so had to return much disappointed. He did not get back till dark. I have never seen him so tired, and very depressed over his failure. It is hard to realise that one is not young any more! He could have done it so easily 6 years ago. However, from the naturalist's point it has been a thrilling day.

A flock of Grandalas at 13,800 ft. about 45 birds, flying very like starlings he said. Then a single pair by themselves. Thrushes large and powerful, size of a mistle thrush, strong flight, dark olive brown, no spots on the back. A willow-warbler at 13,100, very dark green, no wing bar or eyebrow; choughs also about 13,800 ft. Bush warblers up to 13,500, white-capped redstarts to 14,000. Tits (*rubidiventris*) to 13,000. Pipits higher still, paired and singing, but he could not say of what species. He brought down a tin full of flowers. A lovely deep pink primula on a very short stem growing from 13,000 to 14,000 ft. This was *Primula deuteronana*, peculiar to Nepal, Mr. Ludlow tells me. Then there was a yellow primula like a cowslip with an orange eye, *Primula strumosa*, at 13,000 ft. growing on very steep ground where the snow had just melted. A tiny potentilla, *P. monanthes*, 1 in. high nestling in damp moss above 13,000 ft.; very few of these. *Potentilla peduncularis* from 11,000 to 13,000 ft., *Primula petiolaris* very nearly to 13,000 ft. Juniper scrub up to 13,100 ft. and above this only leafless berberis and the 2 dwarf rhododendrons. A tiny extraordinary saxifrage-like flower was unfortunately too dried up to be preserved. But most exciting of all was a most beautiful large yellow primrose with fringed petals, an orange eye, and lovely silvery leaves. This was growing at 11,300 ft. under a boulder, so close to a stream that when it was dug up the hole left behind immediately filled with water. This was the most beautiful flower that we found on the whole trip and we took it back to Kathmandu where it survived for a week in damp moss. We did not know that it was a rare plant until I had taken a small piece home for identification. It proved to be *Primula aureata,* and Dr. Fletcher of the Royal Horticultural Gardens at Wisley writes of it as follows, 'This is the first time it has been found in the wild condition. It has been in cultivation for some years but never has it been found in the wild before. We grew it in Edinburgh among a batch of seeds of *Swertia purpurea.* There was one seedling different from the others and the seedling turned out to be not a *Swertia* but this primula. It has never been seen in any herbarium, and no collector, in particular the collectors of the Lloyd Botanic Garden, Darjeeling, from which the seed came, had ever seen the plant.' My day was spent on the Thare Pate ridge. I followed it up to 13,000 ft. It was a divine day, the only wholly fine day of the whole trip. Wonderful to sit in this golden world, basking in the rare sunshine. Large Whiterumped Swifts with forked tails hawked back and forth. Himalayan Swiftlet with them, and once an Alpine Swift cut across with the sound of a whip lash. In the golden air swarms of tiny midge-like creatures hovered. I could see dozens of these swarms like little puffs of smoke. Sometimes one of these swarms would surround me, but though they got into my eyes and landed all over my face and hair they did not appear to bite. A small eagle (hawk eagle ?) soared above, it had a light band in its tail and was barred on the breast. A black drongo unexpectedly flew across the ridge. In this sunshine one could almost see the leaves and flower-buds opening. *Rhododendron lepidotum*, bare till a few days ago, is now a mist of tiny green leaves, and *R. anthopogon* is covered with yellow flowers. The leaves of both of these smell deliciously when crushed, so that one walks through waves of aromatic fragrance, and shoes and skirt smell delightfully for hours afterwards. They cover the hillsides from 13,000 ft. where the juniper ceases. A yellow potentilla with pinnate leaves, *P. peduncularis*, is abundant. The leaves are just opening and give the appearance of fluted velvet from the long silvery hairs which cover them. They are soft to the touch as a horse's chin or the skin of a peach. A little blue gentian, a tiny bunch enclosed in square bracts is *Gentiana capitata*. This was also common on our marg.

Even the berberis is beginning to show a glint of green and roses are appearing everywhere in most unexpected places. *Cassiope fastigiata* is common, sometimes making a thick carpet, but only one or two flowers appearing. Grosbeaks are found up to the limit of the juniper; tiny little bushes are enough for them. Rosefinches also, but not quite so high. Even this one fine day was not allowed to last and by 3 p.m. the mists were down blotting out the mountains and spreading a clammy dampness over everything.

May 16th: We have only 3 days left and had meant to march back to-day to our rhododendron hill, but could not tear ourselves away. Spent the morning trying to identify the thrush which sings each morning on the ridge behind our camp, but without success. Again and again we stalked him from below (it was always impossible to get above him) but always he flew away while well out of range. It may be an *Oreocincla* but certainly not *dauma* which can be recognised instantly by his peculiar shape. It might be *molissima* or perhaps *dixoni* which I do not know. *Molissima* is common in the Nepal valley in winter, as is *dauma*. A pair of firetailed sunbirds joyously searching for a nesting site; the female carried bits of nesting material but not the male. No last sunset, but a hailstorm rather fiercer than usual.

May 17th: A divine morning after a hard frost. All the wood of the hut rimmed with white. Impossible alas to stretch our time into another day. We leave early. How the summer has advanced since we came up here. Roses everywhere, berberis in young leaf, bird cherries in full bloom, *Rhododendron campanulatum* past its best, and anemones everywhere, thicker than ever before, more of the yellow variety amongst the blue and white. A few white orchids (*Pleione*) coming out. A few weeks later they were abundant and in full bloom we heard from friends. At 9,000 ft. we met parties of Sherpas coming up with their chumries. They told us that they got these chumries from Kuti in Tibet. This is up the Sun Kosi valley and seems a very long way for them to travel. Yaks of course could not live here on the south side of the high hills. They had a number of young calves with them, so I presume that unlike mules chumries can breed. The Sherpas said they did so. I have heard since that only the cow chumries are fertile and that they breed these again with the hill cattle. I should like to know more of the lives of these Sherpas. What a very delightful life they lead. They all look very healthy but seem to suffer from perpetual coughs.

For once there was no storm. In many ways the weather has been kind, and we have never got soaked while moving camp. This is a long day, the last climb from Gol Bhanjyang to Mamche Danda seems very long. The coolies are tired but cheerful and delighted to be on the way home. Camp in our usual spot, a lovely mellow evening. Birds nesting everywhere, sivas, yuhinas, scimitar babblers, etc.

May 17th: Back to Kathmandu. A very hot walk down to Pate Bhangyang and hotter climb up to Sheopuri. Here a violent storm hits us, floods of rain, hail, thunder. I have foolishly worn my light boots with rubber soles. Impossible to stand up in them on these slippery paths. Am obliged to wait for the coolies and my nailed shoes. I take refuge in a hut. It is dark, full of blinding smoke. Every one as usual very cheerful and they make room for me by the fire. I can only see the ring of faces lit by the fire. Soon I am so badly bitten that I am obliged to go out. Everyone astonished that I should leave before the storm is over. I stand on the verandah and scratch. The rain stops, the sun shines out catching a million sparkles of light from the drenched forest. Birds sing. My late companions emerge one by one from the dark hut. I had thought the hut might hold 12 people, 28 come out!

The coolies and my shoes arrive. Nothing more now but to climb down the steep path, past Sandarigal the stream now flooded with dark boiling water from the storm. How sad and how sad! But what a perfect fortnight it has been!

BIRDS SEEN ON GANDAK-KOSI WATERSHED DURING FIRST HALF OF MAY

Nucifraga caryocatactes: Himalayan Nutcracker.

These birds were always in family parties so must breed very early.

Lophophanes rubidiventris: Rufousbellied Crested Tit.

Very common 10,000-12,500 ft. Most were feeding young in the nest.

L. ater aemodius: Himalayan Cole Tit.

Very common from 9,500-11,000 ft. Abundant round our camp at 10,500 ft. Most had nests, but less advanced than last birds, and many still building or incubating.

L. dichrous dichrous: Brown Crested Tit.

Also breeding between 11,000 and 11,500 ft.

Suthora fulvifrons: Fulvous-fronted Suthora.

A party of about 30 birds creeping about in bamboo scrub at 11,300 ft. on the pilgrim trail. They looked very like the English Bearded Tit and kept up a continual thin squeaking. 3 shot had their bills full of crushed bamboo.

Ianthia ocellata: Whitespotted Laughing-thrush.

Common in small parties from 9,500-11,500 ft. It has a most beautiful very human whistle, which might be syllabified *Tu wee, Tu wee, Tu witty O.* I had not seen them last year in March, but as they are very shy and skulk out of sight, they would probably never be noticed when not calling.

Trochalopterum affine: Blackfaced Laughing-thrush.

Common above 9,000 ft. 2 shot varied somewhat in colour, one having more grey on the neck.

Leioptila capistrata: Blackheaded Sibia.

A few up to 11,800 ft. there had been none above 9,000 ft. in March.

Siva strigula: Stripethroated Siva.

Very common up to nearly 12,000 ft. We had not seen any above 9,000 ft. in March. A great variety of notes not heard in winter. Call a loud *Chee-er Chee-er*. Song rather a jumble, some sweet notes mingled with harsh squeaks and churrs. They were in large parties above 9,000 ft.; below this already paired and nest building.

Yuhina occipitalis : Chestnutnaped Yuhina.

Very common above 9,000 ft. I found a nest at 10,500 ft. on the 10th of May. It was a cup of moss and leaves, built into a large lump of moss which formed a dome over the nest. It was in the fork of a small tree about 3 ft. from the ground, and well concealed as large lumps of moss are found on practically every bush and tree in these damp hills. It was lined with fine roots and contained 2 young perhaps 3 days old, they were sparsely covered with long black down. The parent was very tame and would sit brooding them when we were only a few feet away. It would have been an ideal subject for a bird photographer. The white ring round the bird's eye and dark moustache stripe showed up very clearly.

Certhia discolor : Sikkim Tree-creeper.

Common up to 9,000 ft.

Certhia familiaris mandelli : Nepal Tree-creeper.

This bird takes the place of the last from 10,000 ft. up to 12,500 where it is very common particularly on birch. Sir Norman Kinnear kindly identified it for me.

Troglodytes t. nipalensis : Nepal Wren.

Very common round about 12,000 ft. and not seen below this. In March they had been common at 10,000 ft. They were singing with great vehemence.

Larvivora brunnea : Indian Bluechat.

Common above 8,000 ft. The males were singing continuously and always from the same place. I saw no females so perhaps they were incubating. Frequently sang from some exposed position such as the top branches of a silver fir. In Kashmir I have only heard them sing from dense cover.

Heteroxenicus cruralis : Whitebrowed Shortwing.

A pair frequented the top of a small hill near our camp at 10,500 ft. Both sexes sang, a gentle but merry little warble which might be syllabified *Hey did-dle did-dle the cat an.* This was a sight record only.

Grandala coelicolor : Hodgson's Grandala.

My husband saw a flock of about 45 birds at 13,800 ft. on the pilgrim trail. At first he mistook them for starlings. He also saw one solitary pair.

Tarsiger chrysaeus : Golden Bush-robin.

Very common at 12,000 ft. In pairs and several females appeared very anxious as if they had nests. I found a nest on my last day at Thare Pati. It was not quite completed, built of moss into the roots of a juniper on a small bank. Only the female was working on it. I had not time to watch for long. They had harsh churring notes. I never heard a song.

Turdus albocinctus : Whitecollared Blackbird.

Common on all the ridges above 8,000 ft. and up to 12,000 ft. and the limit of the trees. The wild sweet song was a characteristic sound through the rain and mist.

Oreocincla ?

A thrush was common at Thare Pati. It had quite a fine song and sang every morning from the top of a small juniper bush or from a rock on the steep bank behind our camp. Through glasses I could just see that it was a dull white below heavily spotted with dark brown, but as it always kept above us against the skyline the colours could never be made out distinctly. It had not the peculiar shape of *dauma*, so was probably *O. mollissima*. Both these birds are common in the Nepal valley in winter, the latter very shy and skulking.

Siphia strophiata : Orangegorgeted Flycatcher.

Almost the commonest bird above 9,000 ft. They were just arriving in March last year, when we saw only one; now every little valley had its pair.

Chelidorhynx hypoxanthum : Yellowbellied Flycatcher.

Common from 9,000-11,000 ft. Paired. Last year in March they had not arrived. I was surprised to find no Sooty or White-browed Blue Flycatchers. Fair numbers pass through the Nepal Valley in April on passage and I had expected to find them breeding here, but did not see one.

Phylloscopus pulcher : Orangebarred Willow-Warbler.

Common from Rhododendron Hill at 8,400 up to 12,000 ft. Abundant at 10,000 where it was breeding. None left on the Mamche Danda where they had been so common in March.

Phylloscopus proregulus chloronotus :

Fairly common at about 10,500 ft. Paired and singing and frequenting silver firs. I did not find a nest.

P. trochiloides trochiloides :

Very common from 10,500 ft. up to the limit of the trees about 12,000 ft. Two shot were in breeding condition. They were singing but not yet paired.

Seicercus burkii : Blackbrowed Flycatcher-warbler.

Extremely common from 10,000-12,000 ft. None had been seen in March. They were all in pairs and the males (?) kept to the upper canopy of the trees and sang loudly. This was answered by other males from other groups of trees. The females (?) crept about in the undergrowth and answered their mates with the single *chip* note which both sexes use in their winter quarters. The song has a slight resemblance to that of the greyheaded flycatcher-warbler but is quite distinct to any one who knows the latter.

Horeites brunnifrons : Rufouscapped Bush-warbler.

One of the commonest birds from 10,000 ft. up to 13,000 and even higher. It is found in bushes round the open margs, and in the sparse juniper scrub on stony hillsides where no other birds are to be seen except *Anthus roseatus*. It has a loud little song *sip ti ti sip* uttered continuously. This is often followed by extraordinary sound rather like that produced by somebody blowing through a comb. Though it skulks in bushes it is not at all shy and will perch on the top of a bush or rock to utter its song within a few feet of the watcher. I think that nesting had not actually commenced. I found an old nest in a rose bush which probably belonged to this bird, a little domed structure, thickly lined with feathers, still warm and cosy after a winter's rains and snows.

Perissospiza icteroides : Black-and-Yellow Grosbeak.

Rather scarce but small parties seen from 10,500 to 1,200 ft.

P. carneipes : Whitewinged Grosbeak.

Very common from 10,000-12,000 ft. always in flocks. I did not find that this bird replaced the Black-and-Yellow Grosbeak in the higher hills as stated in the Fauna. On the contrary they occupied the same habitat, and the present bird was found at lower elevations than the last.

Mycerobas melanoxanthus : Spottedwing Grosbeak.

My husband thinks he saw this bird at 10,500 ft. A small flock were seen this winter ('52-'53) in Kathmandu and one was shot by Dr. R. L. Fleming, so they probably do breed in these hills.

Carpodacus rhodochrous : Pinkbrowed Rosefinch.

Common from 10,000-12,000 ft. They have a sweet little lilting song very characteristic. This finch is easily confused with *C. pulcherrimus* which may have been present also, but 2 birds shot were identified in the Natural History Museum as of this species.

C. rhodopeplus : Spottedwing Rosefinch.

Very common 10,000-11,000 ft. They feed a great deal on the ground when the female at a distance might be mistaken for a bunting. They have a sweet far-carrying canary-like chirp.

Procarduelis nipalensis : Nepal Dark Rosefinch.

The commonest finch, abundant at 10,500 ft. in large flocks of both sexes, often with mixed parties of tits, etc. Feeding largely in the rhododendrons; the birds often had so much pollen on their heads as to appear as if they had light caps. The call is a rather wailing plaintive double whistle, very characteristic; I heard no song.

At least 2 other species of rosefinches were seen indistinctly, and not identified for certain. No buntings were seen though they had been so common in March.

Delichon nipalensis : Nepal Martin.

Flocks seen at 6,000 ft. No swallows or martins seen above 7,000 ft.

Anthus hodgsoni : Indian Tree-pipit.

Breeding birds were seen in pairs singing and soaring on the inner hills from 9,500-10,500 ft. They seem to occupy a definite zone between the lower hills (8,000-9,000 ft.) where the Upland Pipit is common, and the higher hills above 10,500 ft. where all the birds found by us were *A. roseatus*. Non-breeding birds were common in flocks at 10,500 ft. and I wondered if these were passage migrants for the mountains of Tibet, etc.

A. roseatus : Hodgson's Pipit.

This pipit was the common one from 10,500-13,000 ft. All the little bare rounded hills about 12,000 ft. were occupied by a pair of these birds. My husband saw pipits at 14,000 ft. but could not identify them. I hope to collect some and study all the pipits more attentively another year.

Aethopyga ignicauda : Firetailed Sunbird.

Very common from 11,500-12,500 ft., never seen below this. They were feeding on *Rhododendron campanulatum*. Females very much in the minority, and one female often had 3 or more males vying for her favours. Some already paired were apparently searching for nesting sites, and this was often in juniper bushes. I saw several females collecting cobwebs, but they would carry these from place to place and then abandon them as if the nesting site had not yet been decided, or perhaps this was a sort of courtship display. The male would accompany the female singing joyfully, but I never saw him carry anything. These birds are very local in their distribution. In winter January-February I have seen them only on the Chandragiri Range at a height of 7,000 ft. The males are then in eclipse plumage and are found feeding on a small jungle tree. *Leucosceptrum canum* (?), Dr. Ripley also mentions finding them on this ridge in winter. On March 22nd this year we climbed to the top of Sheopuri, at 8,000 ft. north of the Nepal Valley, and we found the place literally swarming with these birds feeding on *Rhododendron arboreum*. There were often 3 or 4 birds to one tree. The curious thing is that they were confined to a narrow triangle perhaps ¼ mile on each side. Although the rhododendron was in flower all over the hills at this time, I never saw these birds anywhere else. The males were now in breeding plumage, the central tail feathers not very long. Two birds were shot and these long feathers were 25 and 32 mm. beyond the rest of the tail. The Nepal Sunbird, very common all over the hills, was never seen in the area occupied by this species, but was found immediately outside this bird's territory. On April 13th we again climbed up Sheopuri to the same place and these birds had all gone, we did not see one, although the rhododendrons were still in flower, and the Nepal Sunbird had moved in to replace it. Now we met them again at 12,000 ft. and the central tail feathers were very long, (89 mm. beyond the rest of the tail in one we shot) and fluttered behind the bird like the plumes of a miniature paradise flycatcher. I wonder how long they remain at this height. Mr. B. E. Smythies did not mention them when here in September, and they are not birds one could overlook, so presumably they had migrated elsewhere. Where I wonder? I have never seen them in the hills round the valley before January. They are surely the most exquisite birds in the world.

Picus squamatus: Green Woodpecker.

Fairly common about 10,500 ft.

Dryobates darjellensis: Pied Woodpecker.

8,000-10,500 ft., rather scarce.

Cuculus canorus: The Cuckoo.

Extremely common 8,000-13,000 ft. Above 10,000 ft. was not heard till quite late in the day, 11 a.m. onwards. As they usually call with the first light I imagine they roost at lower elevations and range over the high hills during the day. Usually in pairs and they 'cursed' as often as they 'cuckooed'.

C. optatus Himalayan Cuckoo.

Very common from 6,000-8,000 ft.; not much above this.

C. micropterus: Indian Cuckoo.

Very common up to 10,000 ft., and at 12,000 we could sometimes hear its call drifting up from the valleys below. It is the earliest bird to call in the morning, and also sometimes at night.

Hierococcyx sp?

One of the Hawk Cuckoos is extremely common in these hills between 7,000-10,000 ft. I have spent hours stalking it but have failed to get a proper view or a specimen. On the wing it appears very dark. Calls endlessly from just before dawn till late in the evening, occasionally at night.

Surniculus lugubris: Drongo Cuckoo.

Not very common, and not heard above 7,000 ft. There are so many cuckoos in the lower hills 6,000-9,000 ft. that one wonders that there are sufficient fosterers for them.

Micropus pacificus: Whiterumped Swift.

Common on the ridge above Thare Pate 12,000 ft.

Falco tinnunculus: Kestrel.

Seen up to 12,000 ft.

Ictinaëtus malayensis: Black Eagle.

To 9,000 ft.

Spilornis cheela: Serpent Eagle.

To 10,000 ft.; rather higher than I had expected.

Sphenocercus sphenurus: Wedgetailed Green Pigeon.

Common up to 8,000 ft.; not seen higher.

Ithaginis cruentus: Blood Pheasant.

Fairly common on the pilgrim trail beyond Thare Pate between 11,000-12,000 ft. In small parties which seemed to consist of more cocks than hens, unlike the commoner Monal, whose cocks always had a large harem to themselves. They were very tame and would utter a soft *kik kik* as they worked through the bamboo and fir forest. I never saw them in the open where the monal spent most of their time.

Scolopax rusticola: The Woodcock.

At our camp at 10,500 ft., a Woodcock used to appear each evening just before dusk and fly round and round the marg, a circle of about ¼ mile, uttering a deep croak and sometimes a shrill squeaking. Once I saw 2 of them together for a short time. The evenings were usually fine, and it was pleasant to watch them against the sunset sky and magnificent panorama of mountains.

OCCURRENCE OF *PARAGREWIA* GAGNEP. IN INDIA AND BURMA[1]

BY

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(*With a plate*)

While studying the Indo-Burmese species of *Grewia*, I came across a few specimens kept under 'dubia' of the Calcutta and Madras Herbaria. These turned out to be very interesting specimens of a totally new species of the mono-specific genus called *Paragrewia*. They were collected from Burma and Tinnevelly (South India). They resemble *Grewia* in the general form which led the earlier workers to suspect them as a species of *Grewia*. But they are strikingly different in their floral structure.

Gagnepain in 1945 published this monotypic genus *Paragrewia* with description and diagrams in 'Supplementà la Flore Generalé de L' Indochine I'. He named it as *P. poilanei* Gagnep. after Poilane, who collected it from Quang-nom, Annam. *Paragrewia*, though it resembles *Grewia* in habit, general form of leaf and structure of ovary, however differs from it (1) by the absence of the androgynophore and (2) also of glandular depression at the inner base of the petals and by (3) the presence of limited number of stamens, not exceeding 15. The type sheet could not be secured for comparative study from the Paris Herbarium where it is supposed to have been deposited. But the exact matching of these specimens with the published diagrams and the complete agreement of description with that of Gagnepain leave no doubt about their correct relationship with *Paragrewia poilanei* Gagnep.

A Latin diagnosis for this new genus is also added here as it was not given by Gagnepain.[2]

Grewia similis est *Paragrewia* habitu, generali forma folii atque ovarii structura, sed ab ea differt in eo quod deest androgynophorum nec interior petalorum basis glandulis depressa est et quod adsunt pauca tantum stamina, i.e. 15 numero.

A detailed description of the species in English is given below (Plate 1):—

Description:—Shrub; *Branches*: slender, glabrous, 2-3 mm. in diameter. *Leaf*: alternate, stipulate, (stipules deciduous), petiolate, petiole glabrascent, 6-10 mm. long, lamina 11-17 cm. long, 2.5-4 cm. broad, leaf base nearly obtuse or slightly pointed, oblanceolate or nearly elliptic, entire, acuminate, membranous, glabrous on both sides, 3-nerved at base, 5-8 pairs of secondary nerves, pinnately reticulate. *Inflorescence*: axillary, cymose, few-flowered. *Flower*: short-pedicelled, bracteate, actinomorphic, hermaphrodite, hypogynous. *Sepals*: 5, 6-8 mm. long, free, valvate, finely pubescent on upper surface. *Petals*: 5, minute, free 1-1.5 mm. long, imbricate hairy all over, marginal hairs prominent, glandular depression at the inner base absent. *Stamens*: 10-15 united at the base around the ovary, a few reduced to small conical staminodes with a few hairs at the tip (*a*, fig. 6, Plate I), filaments slender, slightly hairy, anthers dithecus, oblong, introrse, basifixed, dehisce by longitudinal slits. *Gynoecium*: on glandular thalamus, androgynophore absent, style as long as stamens, partly hairy, stigma pointed, 3-4 branched, ovary pilose, 3-4 celled, ovules numerous on axile placentae. *Fruit*: not available.

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[1] Read at the Thirty-sixth Session of the Indian Science Congress, Allahabad, but much enlarged.

[2] My thanks are due to Rev. H. Schefers, S.J., the Prefect, St. Xavier's College, Calcutta, for supplying me the Latin translation.

Specimens examined:

Burma: Salween. ('*Grewia laevigata* Vahl', Meebold, 16898, Jan. 1912, Calcutta Herb. No. 61496).

India: Tinnevelly. ('*Grewia viminea*', Major R. H. Beddome, collected in 1807, Madras Herb. No. 6383). Kannikatty: 3,000 ft. Tinnevelly Dt. ('Grewia', K. C. Jacob, 20-9-1921, Madras Herb. No. 85714. 2 sheets.)

Distribution:—Gagnepain stated that the genus with its single species was confined to South de la Province de Quangnom (16° lat., 108° long.) of Annam. In the light of new records above stated, it is clear that the Annam species occurs also in Salween (18° lat., 97°-98° long.), Lower Burma and in Kannikatty and Tinnevelly district (8°-9° lat., 77°-78° long.) of South India. Strangely enough, the species is not so far recorded anywhere between Annam and Lower Burma and between Lower Burma and the southern most part of Peninsular India. Such a discontinuous distribution is not uncommon among different species. Our recent collections from the Rampa and the Gudem Agency tracts of the Andhra region reveal the occurrence of a few Himalayan, Burmese and Andaman plants in such far distant hills of the Eastern Ghats. The peculiar distribution of *Paragrewia* may be well explained by the collection of a few more species of this genus by a detailed exploration of the intervening regions between India and Burma and Burma and Annam.

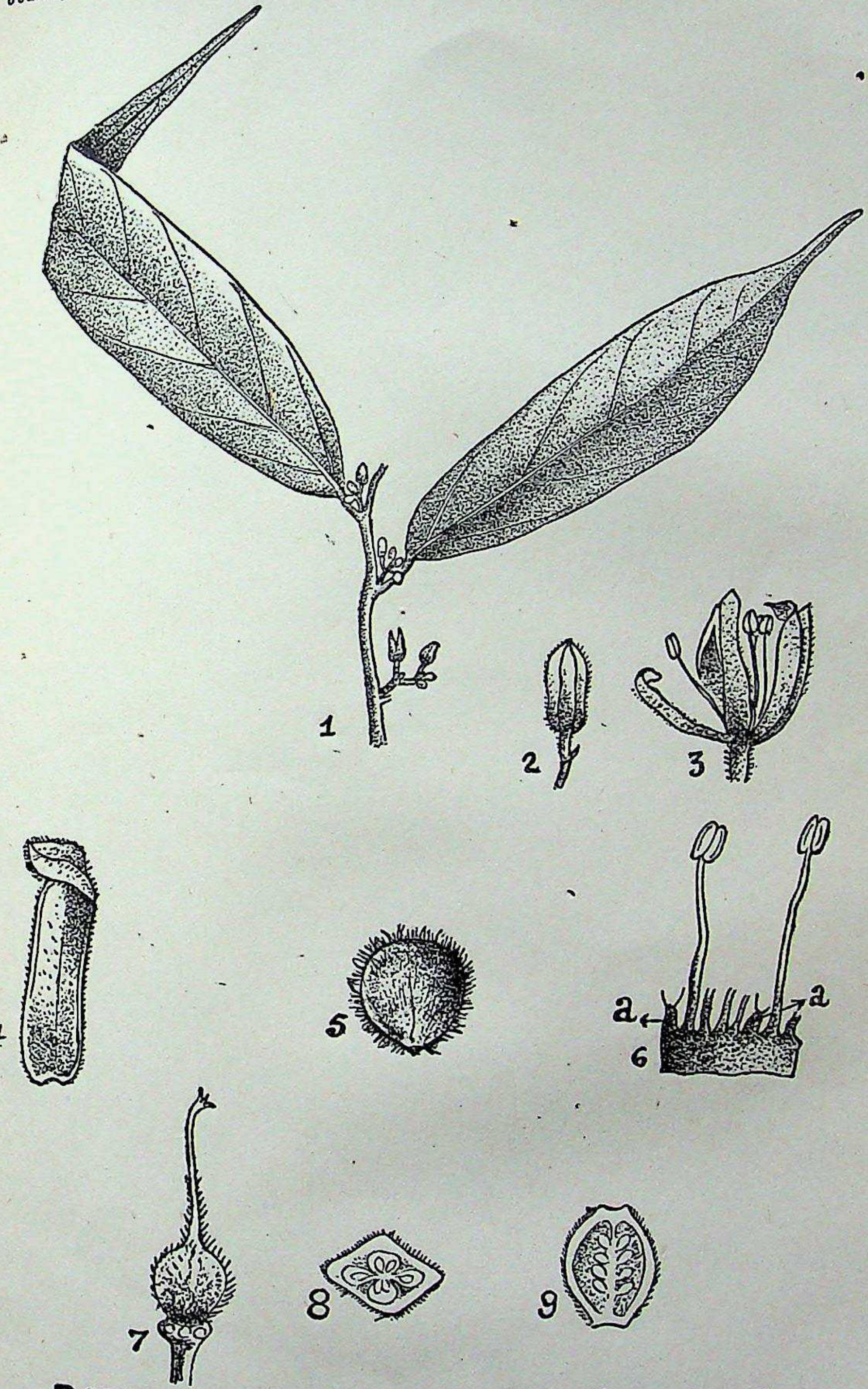
SUMMARY

The occurrence of an Annam species, *Paragrewia poilanei* Gagnep. in Salween (Burma) and in Tinnevelly (South India) has been reported with a detailed description.

ACKNOWLEDGEMENTS

The writer wishes to express his sincere thanks to Dr. K. Biswas, Superintendent, Indian Botanic Garden, and Sri V. Narayanaswami, retired Systematic Assistant, Calcutta Herbarium, for their helpful suggestions and encouragement.

Journ., Bombay Nat. Hist. Soc.



PARAGREWIA POILANEI *Gagnepain.*

Fig. 1. Shoot with flowers. ×½
,, 2. Flower bud. ×3
,, 3. An open flower showing sepals and stamens. ×4
,, 4. Sepal. ×6
,, 5. Petal. ×10
,, 6. Stamens and staminodes (*a*). ×8
,, 7. Gynoecium with glands on the thalamus below the ovary. ×6
,, 8. T.S. of ovary. ×10
,, 9. L.S. of ovary. ×10

पुस्तकालय
गुरु

[In 1945, according to the author of this paper, Gagnepain published the new genus *Paragrewia* but without giving a Latin description of the genus; this procedure makes Gagnepain's publication invalid in the sense of the Code of Botanical Nomenclature, art. 44. This article enjoins that 'on and from 1 Jan. 1935, names of new taxa of recent plants, the bacteria excepted, are considered as validly published only when they are accompanied by a Latin diagnosis'. In consequence, the generic name *Paragrewia* cannot be attributed to Gagnepain, but must be attributed either to 'Seshagiri Rao' or to 'Gagnepain ex Seshagiri Rao' and the date of valid publication is only that in which the Latin diagnosis was supplied, that is to say, the date of publication of Seshagiri Rao's paper in the *Journal*. And if the genus is not validly published the same may be said about the species of *Paragrewia poilanei,* which therefore should be credited to the same author or authors who validated the publication of the genus, that is to say Seshagiri Rao or Gagnepain ex Seshagiri Rao.—EDS.]

A CONTRIBUTION TO THE BIOLOGY OF THE BLUE SWIMMING CRAB, *NEPTUNUS PELAGICUS* (LINNAEUS), WITH A NOTE ON THE ZOEA OF *THALAMITA CRENATA* LATREILLE[1]

BY

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(*Central Marine Fisheries Research Station, Mandapam Camp.*)

(*With a plate and fifty-eight figures*)

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INTRODUCTION

Considerable work has been done on the biology and fisheries of crabs especially the edible crab of the Pacific coast of North America, *Cancer magister*.[2] Hay (1905), Churchill (1918, 1941 and 1942). Hopkins (1943 and 1944) and Sandoz and Hopkins (1944) have contributed to the life history of the Portunid crab, *Callinectes sapidus*. Lebour (1928) has given a detailed account of the larvae of Portunids of the Plymouth area.

The authors have, in a previous report (1951), made reference to the fishery and fishing methods for *Neptunus pelagicus* the most

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[1] Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp, South India.

[2] For a list of references on *Cancer magister* refer Clever (1949).

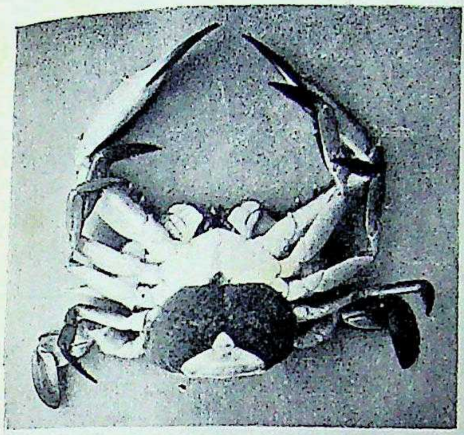
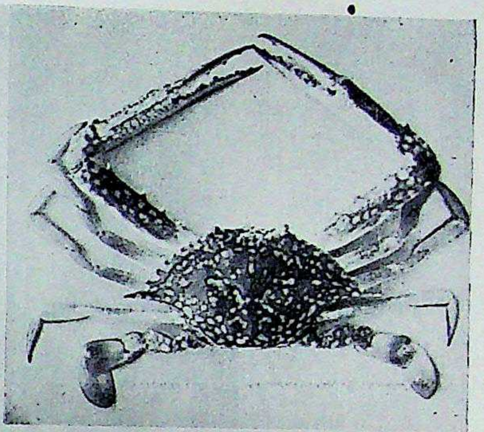


Photo 1



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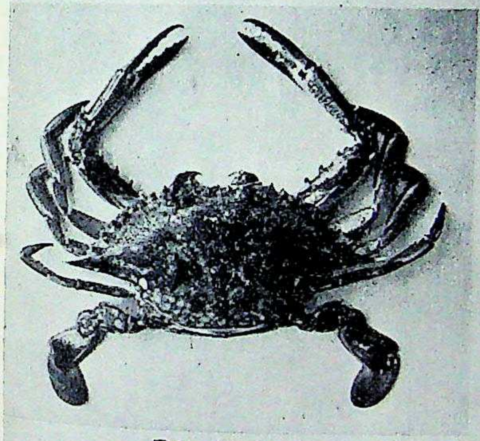

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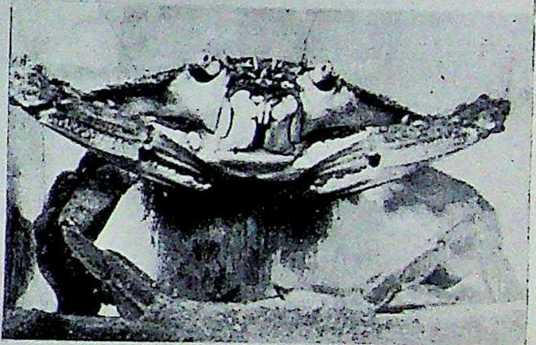

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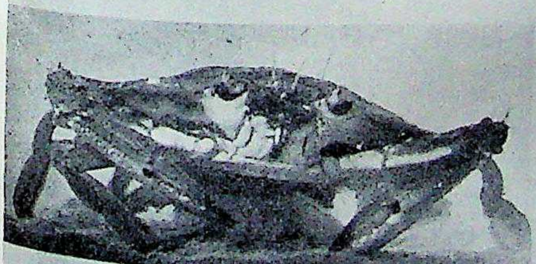

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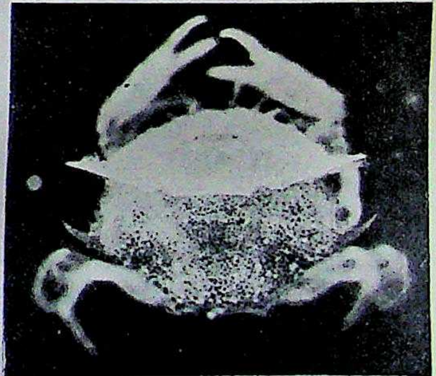

Photo 6

Photo 1. A female *Neptunus pelagicus* showing the 'berry' (130 mm. width of carapace).

Photo 2. A female of the same species. 150 mm. width of carapace.

Photo 3. A female *N. pelagicus*. Width of carapace, 140 mm.

Photos 4 and 5. Female crabs during the process of shedding the eggs.

Photo 6. A juvenile 8.5 mm. during the process of moulting.

common Portunid crab occurring near Mandapam. Little is known about the biology of this species and except for brief reports by Stead (1898) on the genus *Neptunus* and Delsman and De Man (1925) on the 'Radjungans' of the Bay of Batavia there is no detailed account on its development, growth and breeding. The latter have described three stages of zoeae and the megalopa. Their assumption that the various zoeae and the megalopa they were describing, belong to *N. pelagicus* was based only on circumstantial evidence because no other species of crab occurred in large numbers in the area of study. All the larvae, except the ones they dissected out from the eggs, were obtained from plankton. Thomson (1951) has dealt with the catch composition of *N. pelagicus* in the Moreton Bay, Australia.

Although crab fishery is not a major industry in India, it is a source of income to many fishermen of this area particularly during the off-season. At the present rate of exploitation the possibility of depleting the stock may not happen in the immediate future. But in course of time the crab fishery, like any other fishery of our country, has possibilities of expansion. When such expansion takes place, regulatory measures will have to be enforced to safeguard the fishery as is done in other countries where crab industry has assumed a major importance. The existing knowledge of the life history of *N. pelagicus* is fragmentary and not entirely reliable. Detailed investigations were therefore undertaken on this species with a view to collecting as much data as possible to complete a fairly satisfactory picture of its life history.

The authors wish to record here their appreciation of the excellent co-operation they received from the fishermen and the crab vendors, without whose help it would not have been possible to complete this piece of work.

MATERIAL AND METHODS

The habits of the crabs are difficult of direct observation as they are found in fairly deep waters, and as such most of the details, recorded here were observed under aquarium conditions.

Berried crabs were collected from the commercial catches as soon as the nets were hauled out of the water. They were brought to the laboratory in earthenware containers with sea water and released in large glass aquaria with about three inches of sand at the bottom and nearly six inches of water. The crabs seldom survived for more than three or four days in tanks without sand or sufficient water to cover them completely. The berried crabs were never found to feed in the aquaria although plenty of food in the form of pieces of fish, prawns etc., was provided. For most of the time they remained fully buried in the sand with their eyes and antennae alone projecting.

Zoea larvae and megalopae obtained from plankton were kept in small bowls. Because of the cannibalistic tendencies of the megalopae it was found necessary to keep only one in a bowl at a time. Although several efforts were made to rear the zoeae through the different stages, only two attempts proved successful. The zoeae were fed with various planktonic larvae and the megalopae with small bits of muscles of prawns, fish and molluscs.

HABITS AND HABITAT

Neptunus pelagicus occur in large numbers near Mandapam at depths up to about three fathoms and prefer a sandy or sand and mud bottom. They are active and swim sideways with the aid of the last pair of flattened swimming legs as MacGinitie (1949) has described in the case of *Portunus xantusi*: 'As they swim sideways they streamline themselves by sticking one "elbow" of the large claw ahead and leaving the legs of the opposite side straight out from the body.' After leaving the planktonic life the post-larval crabs settle down at the bottom. Just like many other species of crabs these also are scavengers and cannibals. In the aquarium these crabs have been observed to be feeding voraciously on pieces of clam meat, dead prawns and small fish.

There are evidences to show that individuals tend to segregate according to size and sex. The larger ones are generally found in deeper water, whereas the smaller ones inhabit shallower areas. This segregation according to size is clearly seen from the landings of two types of nets operated at different depths. The size frequency distribution of crabs caught by the 'nandu valai'[1] is given in Figure 1 which shows that the majority of crabs landed are above 90 mm. and those below 80 mm. have not been caught. This net is usually laid at depths varying from one to one and a half fathoms, whereas the 'konda valai'[2] which is generally operated from a depth of about three feet catches crabs which invariably never exceed 80 mm. in carapace width. The size frequencies of crabs caught by the 'konda valai' are shown in Figure 2. Segregation according to sex is observed only among the larger individuals.

The crabs are able to withstand considerable variations in temperature and salinity. This is seen from the fact that they are found in fair numbers in the shallow lagoons near the Palk Bay during February when the temperature in the lagoon may go up as far as 35°C and the salinity as high as 43 $^{\circ}/_{\circ\circ}$. However, during March a marked decline in their numbers was observed in the same area and several dead ones were also noticed, perhaps, due to the very high temperature (40°C) and salinity (67.86$^{\circ}/_{\circ\circ}$). Similarly they are also found in large numbers in localities where the salinity is very low. Kemp (1915) has observed that *N. pelagicus*: '. . . . is common in the Chilka Lake, both in the outer channel and in the main area; . . . . It is, apparently, unaffected by alterations in salinity and is equally abundant at all seasons of the year.'

BREEDING HABITS AND SEASON

Stead (1898) has remarked that the spawning season of *Neptunus* in Australian waters is about August to November, whereas according to Thomson (1951) the egg bearing season is from September to April. Delsman and De Man (1925) have not observed any such

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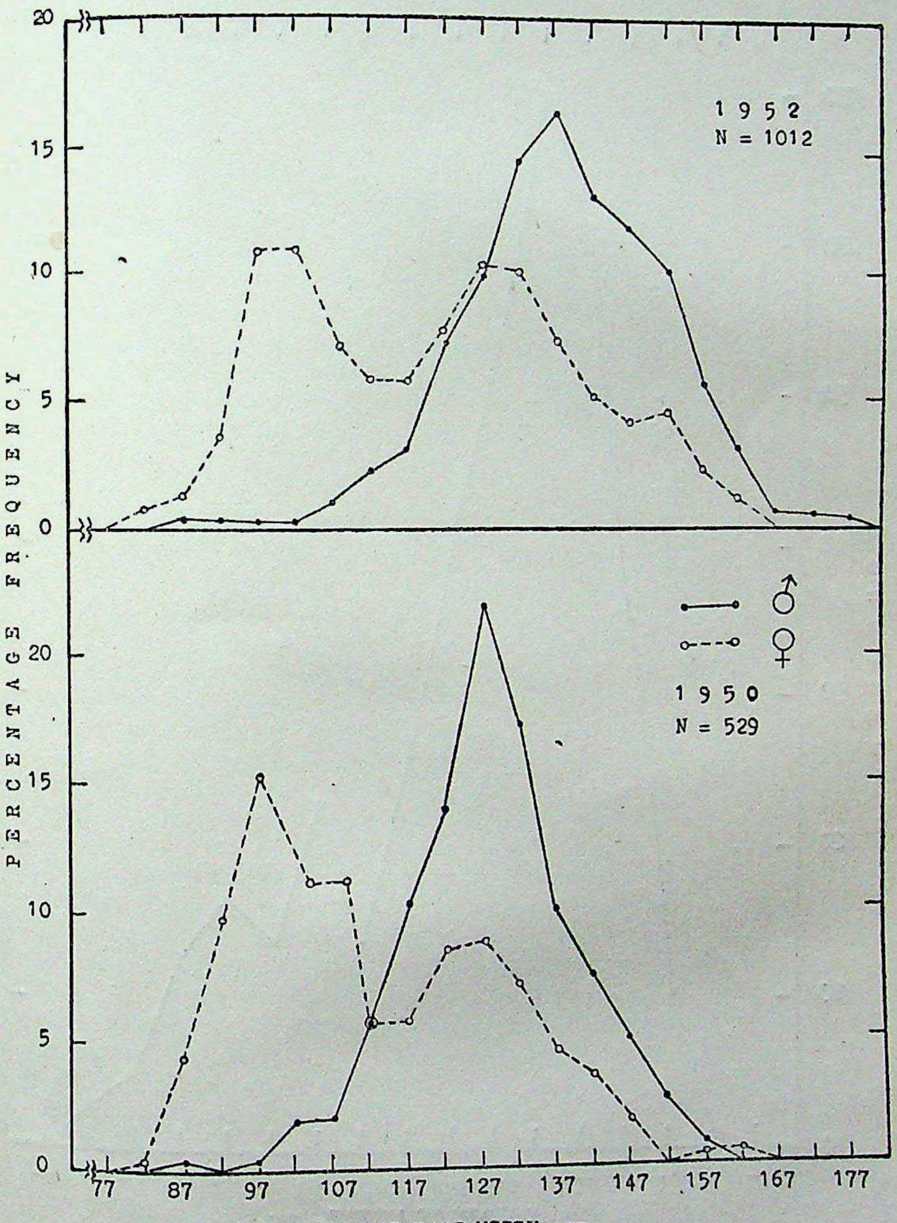
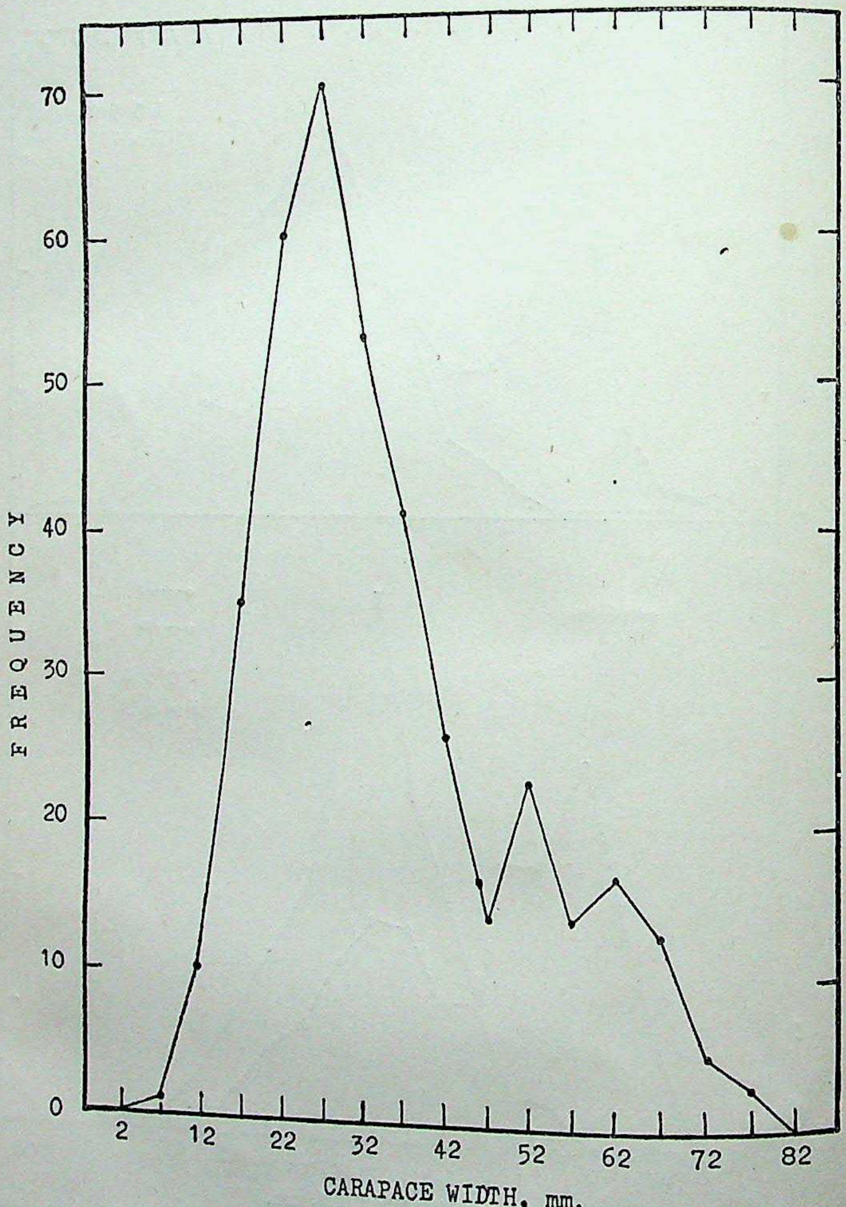
[1] For details regarding 'nandu valai' refer Prasad and Tampi (1951).

[2] A small drag net which is used in shallow waters to catch prawns and small fish. For details refer 'Preliminary guide to Indian fish, fisheries, methods of fishing and curing'. Government of India, Agricultural Marketing Series No. 24, 1941.



Neptunus pelagicus

Fig. 1. Size frequencies of male and female crabs landed at Vedalai.



Neptunus pelagicus

Fig. 2. Size frequency distribution of crabs caught in the 'konda valai'. Sexes combined.

definite breeding period for *N. pelagicus* in Batavia and remark that berried crabs occur throughout the year. Although berried individuals are found throughout the year, observations made locally on the commercial landings as well as occurrence of larval forms in the plankton tend to point to the fact that the maximum breeding activity is during September to March.

Juveniles ranging from 15 to 35 mm. in carapace width were common during November to December and those from 35 to 60 mm. were obtained during February from the Palk Bay lagoons. Results of rearing experiments conducted in the laboratory showed that it took approximately one month for a megalopa to reach 8.5 mm. in carapace width after four successive moults and under the same conditions a juvenile 15 mm. attained a size of 23 mm., after two moults, during the course of three weeks. From these it may be safe to assume that the juveniles obtained from the lagoons during November-December and February belong to the first year class which perhaps were spawned during September-October.

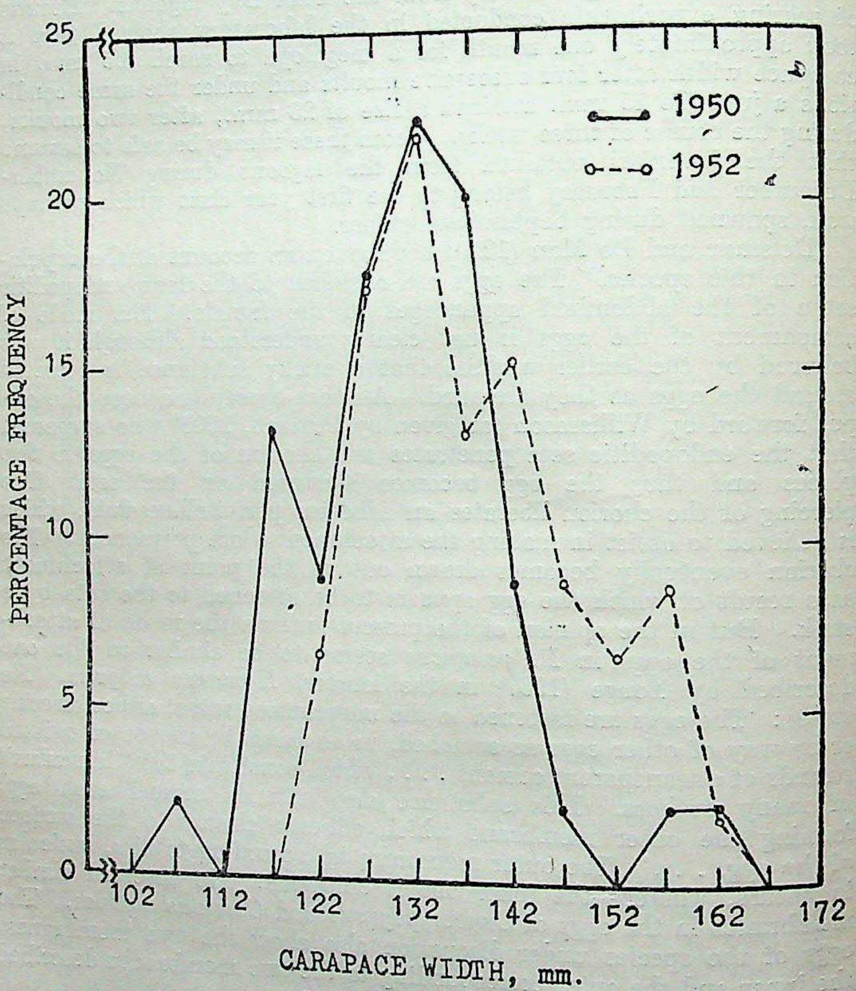
Delsman and De Man (1925) have given an account of the copulation in this species. The eggs are attached to the long endopoditic setae of the abdominal appendages of the female. The mode of attachment of the eggs is not clearly understood although it was believed by the earlier workers that a sticky substance is secreted around the eggs as they are shed. Another theory has been the one put forward by Williamson (as given by Pearson, 1908) who suggested that the endopoditic seta penetrates the chorion of the eggs in two places and thus the egg becomes skewered on the seta. The piercing of the chorion liberates an adhesive perivitelline fluid, which is believed to assist in making the attachment more permanent. The chorion eventually becomes drawn out at the point of attachment as a result of which the egg appears to be attached to the seta by a stalk. But in the opinion of the present authors the mode of attachment of the eggs in *N. pelagicus* seems to be similar to the one described by Yonge (1937) in the lobster, *Homarus vulgaris*. He states: 'The eggs are fastened to the nonplumose setae, either directly or by way of other eggs so attached, in all cases by means of twisted strands of a transparent cement . . . . which constitute the "funiculus" of many authors. This substance also extends around each egg, forming the outer membrane which adheres closely to the surface of the egg. . . .' The outer membrane is, according to him, cuticular in nature, whereas the inner one is chitinous. He observed similar membranes in the eggs of *Cancer pagurus* and *Carcinus maenas*. The eggs of the species under discussion also show the two membranes, the inner and the outer corresponding to the two membranes described by Yonge.

The female crab carries the eggs (Photo 1) until they complete their development and the larvae hatch. Crabs in 'berry' often remain buried in the sand and come out only occasionally perhaps for the aeration of the eggs.

SIZE AT MATURITY AND SEXUAL DIMORPHISM

The smallest crab, so far observed, bearing eggs was 106 mm. and the largest 163 mm. in carapace width. According to Thomson

(1951) the smallest crab bearing eggs was 4.2 inches and the largest 7.1 inches. There is very good agreement in size between the smallest berried crab recorded by Thomson in Australian waters and that recorded by the authors although the largest observed by him is much bigger than the one recorded locally. Figure 3 shows the percentage of ovigerous crabs at different size groups caught at Vedalai. The maximum number was seen in the size range between 125 and 140 mm. in carapace width.



Neptunus pelagicus

Fig. 3. Percentage of berried crabs in the different size groups.

In addition to the direct observations made on the commercial catches, evidences leading to the conclusion that females attain maturity at a carapace width of approximately 108 mm. are forthcoming from studies made on the relative growth[1]. The width of

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[1] Full details of the study on the relative growth of parts in *Neptunus pelagicus* will be published in course of time.

the sixth abdominal segment and the relative growth of the first walking leg in females show abrupt changes at a carapace width of about 108 mm. which may be attributed to the onset of maturity. In the case of males no attempts were made to determine the size at maturity based on the examination of the testes but evidences obtained from the study of relative growth suggest that they attain maturity at a slightly earlier stage. Changes in the relative growth of the first walking leg and the chela were observed in the males at a width of about 102 mm. It is possible that these changes are indicative of the attainment of sexual maturity.

Males and females exhibit distinct sexual dimorphism. The males are brilliantly coloured with the walking and swimming legs having bright blue colour (hence the popular name 'Blue crab') while the females are dull and as Delsman and De Man (1925) have remarked the females do not deserve the name 'Blue crab'. There are no marked differences in the general shape of the carapace between the males and females but the males have relatively longer chelipeds and first walking legs (Photos 2 and 3). The males grow to a bigger size than the females and the largest male recorded in this area is 178 mm. whereas the maximum size of females recorded for this area is only 163 mm.

SEX RATIO

There has always been a preponderance of males over females and the average ratio is 2.4 males to each female. Thomson (1951) has observed that in the Cleveland area the proportion of males to females may be as high as 4.3:1. The greater preponderance of male crabs he attributes to swarming or schooling according to sex. Amongst the juveniles (size ranging from 35 to 80 mm.) there is apparently no marked difference in the sex ratio. From the few samples of juveniles examined it may be said that the ratio of males to females is 1.07:1. This may be due to the fact that there is no segregation by sex within this group.

PARASITIZATION

The data collected from landings near Mandapam show that the incidence of parasitization by the rhizocephalan parasite is low. A little over 2 per cent of the crabs was seen infected but this percentage includes only those crabs in which the parasite was visible externally. George (1943) has remarked that out of the 519 specimens of *Neptunus pelagicus* collected by him at Madras nearly 20 per cent were found to be infected.

DEVELOPMENTAL STAGES AND LARVAL HISTORY

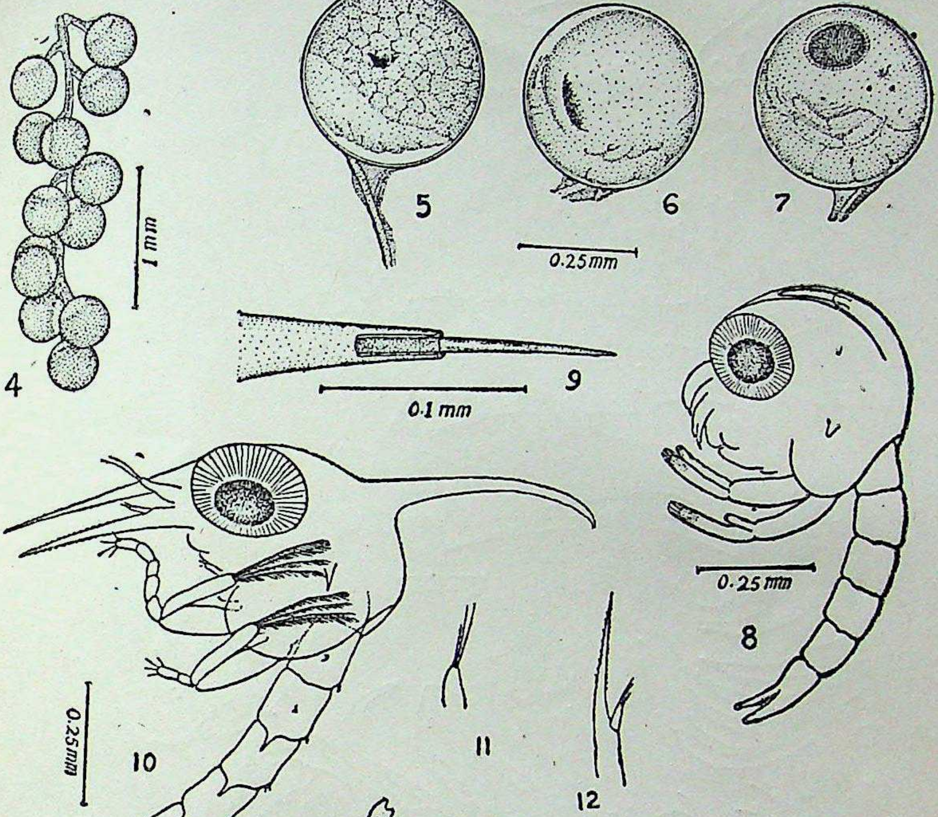
Eggs. The freshly spawned eggs are bright yellow in colour. The number of eggs in a 'berry' is found to vary considerably. A female 157 mm. across the carapace was found to have approximately 191,500 eggs while another one 122 mm. in carapace width carried *ca.* 455,000 eggs. There does not seem to be any definite number of eggs attached to each seta of the pleopod. Figure 4 shows a few eggs attached to the seta. The eggs are spherical with a diameter of 360 to 375 micra, and are surrounded by two membranes, an inner and an outer membrane. Both these membranes are transparent and the yolk is visible as yellow granules with the surface divided into large polygonal areas. No attempts were made at a detailed study of the early embryonal development.

Externally certain changes in the eggs are visible as development progresses. First the animal pole becomes transparent, then the eye spots begin to appear as brownish patches. Gradually the rudiments of the abdomen and cephalic and thoracic appendages are formed (Figs. 5, 6 and 7). Along with these changes the eggs gradually change their colour. From bright yellow they become light brown and then greenish black in the advanced stages. As the embryo grows xanthophores appear on either side of the cephalothorax and abdomen. Just before the larvae are to be liberated the developing zoea can be seen through the transparent egg membrane. At this stage the eyes are black and well developed. The abdomen is curved inwards in such a way that the telson covers the rostral end of the head. It takes about ten days for this development to be completed. All the berried crabs kept in the aquarium liberated the eggs in seven or eight days.

When the embryonic development is complete and just when the larvae are about to hatch the eggs are liberated from the pleopods by a conscious effort on the part of the female crab which carries the eggs. The crab, which mostly remains buried in the sand, comes out and raises its whole body on all the walking legs (Photo 4). The abdomen is fully stretched and the pleopods bearing the eggs are vigorously jerked. As a result of this the groups of eggs round each seta get themselves loosened from the bunch and thereby the compactness of the 'berry' is lost. A few of the eggs are shed during this process but most of them are combed out from the endopoditic setae usually with the help of the stiff hairs along the margin of the terminal segment of the second and third pairs of walking legs (Photo 5). In *Cancer pagurus* Pearson (1908) has observed that the last walking legs are used for the purpose of detaching the larvae from the pleopods. All the eggs are shed in about two hours' time as was observed in a specimen kept in the aquarium. It is a common belief among the local fishermen that the females spawn only once in their life-time and after liberating the eggs they do not live long. The specimens on which the above observations were made died soon after liberating the eggs on the eighth or ninth day of their capture.

Some of the eggs hatch while they are being detached from the endopodites of the abdomen but the majority of them sink to the bottom where the egg membranes burst and the larvae emerge. It has been observed in all cases that the egg-capsules break into two equal halves along a plane perpendicular to the plane of attachment.

In the following pages an attempt is made to give an accurate and detailed description of all features which may be of importance in separating the larvae from those of the different species of Portunids occurring in this area.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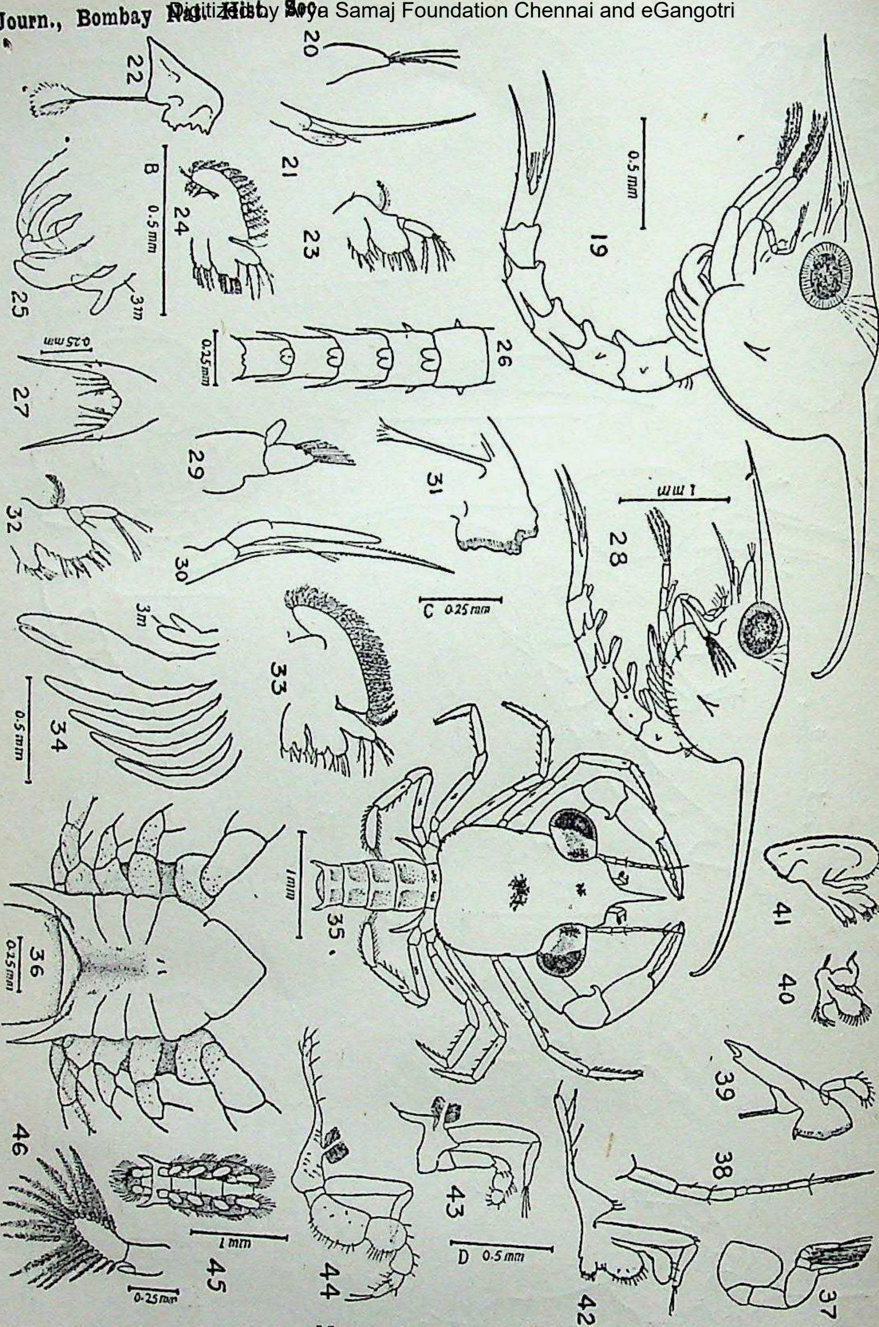
0.1 mm

Neptunus pelagicus

Fig. 4. A group of eggs attached to the seta of the pleopod.
„ 5, 6 and 7. Three stages in the development of the egg.
„ 8. Pre-zoea.
„ 9. A spine showing the telescopic nature.
„ 10. First zoea.
„ 11. First antenna
„ 12. Second antenna
„ 13. Mandible
„ 14. First maxilla
„ 15. Second maxilla
„ 16. First maxilliped
„ 17. Second maxilliped
„ 18. Telson

Scale line A stands for figures 11 to 17.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0.5 mm
20
21
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23
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30
31
C 0.25 mm
32
33
34
3m
0.5 mm
35
1 mm
36
0.25 mm
37
38
39
40
41
42
43
D 0.5 mm
44
45
1 mm
46
0.25 mm

Neptunus pelagicus

Fig. 19. Second zoea
,, 20. First antenna
,, 21. Second antenna
,, 22. Mandible
,, 23. First maxilla
,, 24. Second maxilla

Fig. 25. Thoracic appendages
,, 26. Abdomen
,, 27. Telson
,, 28. Third zoea
,, 29. First antenna
,, 30. Second antenna

Fig. 31. Mandible
,, 32. First maxilla
,, 33. Second maxilla
,, 34. Thoracic appendages
,, 35. Megalopa

,, 36. Sternal plate of the last thoracic segment showing the spine

,, 37. First antenna
,, 38. Second antenna
,, 39. Mandible
,, 40. First maxilla

,, 41. Second maxilla
,, 42. First maxilliped
,, 43. Second maxilliped
,, 44. Third maxilliped

,, 45. Abdomen
,, 46. A single pleopod

Scale line B is for figures 20 to 25
Scale line C stands for figures 29 to 33.
Scale line D stands for figures 37 to 44.

Prezoea (Fig. 8). The newly hatched larva may be distinguished as the pre-zoea. It is enclosed in an extremely thin embryonic cuticle and has a soft body. This larva remains for sometime at the bottom without much active movement except for occasional jerks presumably to cast off the embryonic cuticle. At this stage the front spine of the carapace is bent inwards and almost hidden between the pair of large eyes while the posterior spine remains flexed forwards over the carapace. Both these spines as well as the two forks of the telson have a telescopic construction (Fig. 9). The appendages, although they are free from the body still remain enclosed in sheaths with the terminal setae retracted. The spiniform process of the antenna is short. After the embryonic cuticle is shed the spines of the carapace and the telson get themselves extended presumably due to pressure exerted by the larva and they attain their full length. The larva assumes all the characters of the first free swimming zoea in the course of about two hours. Then the larva moves about actively at the surface. This stage is referred to as the first zoea.

First zoea (Fig. 10). The larvae hatched in the laboratory did not survive for more than twenty hours. Corresponding stages were observed in the plankton taken within one and a half miles from the shore of the Gulf of Manaar and the Palk Bay during September to March. In general appearance this zoea resembles that of many of the Portunids and measures about 1.3 mm. between the tips of the two spines and including the telson the larva is 1.25 mm. in length. The posterior spine of the carapace varies slightly in length and is about 0.5 mm. long terminating in a curved tip while the rostral spine is 0.3 mm. in length and is almost straight and pointed. There is one pair of short lateral spines on the carapace.

First antenna (Fig. 11). It is short and bears three aesthetes at its tip.

Second antenna (Fig. 12) consists of a well developed spiniform process which is nearly as long as the rostral spine and a small exopodite bearing two short setae.

Mandible (Fig. 13) is a single hard chitinous piece with four or five blunt teeth at its cutting edge.

First maxilla (Fig. 14). There is no epipodital hair. The protopodite has two lobes, the proximal or coxopodite bears four setae and the basipodite has five setose spines. The endopodite is two segmented and there are five setae on the terminal segment which is longer than the proximal joint.

Second maxilla (Fig. 15) has six setae on the coxopodite arranged in three and three, eight on the basipodite and six on the endopodite. The scaphognathite is flat and narrow with five plumose setae on its margin.

First maxilliped (Fig. 16). The basipodite bears five setae. There are four long terminal setae or 'swimming hairs' on the exopodite. The endopodite is five jointed and the segments are of unequal length. Two setae are present on the proximal segment as well as the second segment which is the longest. The third segment has no seta while the fourth bears two setae and of the five on the last segment three are long and terminal.

Second maxilliped (Fig. 17) has two setae on the basipodite. The exopodite bears four long 'swimming hairs'. The endopedite which is short and two jointed bears four terminal setae on the basal segment.

Third maxilliped is not formed.

Abdomen shows only five segments, the last one being fused with the telson. All the abdominal segments have a pair of small hairs on the dorsal side. There is a pair of short lateral spines or hooks on the second and third segments. The third, fourth and fifth segments possess a pair of long and downwardly pointed spines from the postero-lateral border. Chromatophores are present on the third to fifth abdominal segments. The pleopods have not been developed yet.

Telson (Fig. 18) is deeply forked with three pairs of setose spines between the forks and two pairs of short spines on the dorsal side of each of the fork as shown in the figure.

Second zoea (Fig. 19). Striking differences from the previous stage are the increase in the size of the larva and the appearance of the rudiments of the thoracic and abdominal appendages. The zoea measures about 3 mm. from spine to spine and is 3.25 mm. in length. The rostral spine is nearly 1 mm. and the posterior one is longer (1.2 mm.) with a downwardly curved tip.

First antenna (Fig. 20) has six aesthetes.

Second antenna (Fig. 21). The spiniform process is much shorter than the rostral spine. The flagellum or the endopodite has made its appearance and is unjointed.

Mandible (Fig. 22). The cutting edge shows a number of irregular teeth and the mandible is provided with well developed muscular tendons attached to its base.

First maxilla (Fig. 23) has two epipodital hairs of which one is plumose. The coxopodite bears eight or nine setae and the basipodite has eight setae. The endopodite is two jointed like that of the previous stage and has six terminal setae.

Second maxilla (Fig. 24) resembles in general shape that of the first zoea with two groups of three setae each on the coxopodite, two groups of five and six setae on the basipodite and six on the endopodite. The scaphognathite is broader with seventeen plumose setae on its margin.

First and second maxillipeds retain their shape and swimming function.

Third maxilliped also has appeared as a rudiment with two lobes (Fig. 25: *3m*).

Thoracic appendages. Rudiments of these show the large cheliped and the four walking legs (Fig. 25). However, the segmentation of these appendages is not very clear.

Abdomen. All the six abdominal segments are distinct. The first segment has three dorsal hairs and does not show the pleopods. Segments two to five possess a pair of prominent protuberances on the ventral side which are the rudiments of the pleopods. The sixth segment also shows the developing pleopods but they are much smaller than the rest. Short lateral spines are present on the second and third segments and the spines on the postero-lateral border of segments three, four and five have become longer (Fig. 26).

Telson has the same shape as that of the first zoea but it shows an additional pair of small spines in the middle of the fork (Fig. 27).

The transition from the first to the second zoea has not been observed in the laboratory. But from a series of collections and comparison with the stages described by Delsman and De Man (1925) it may safely be assumed that there is no intermediate stage between the first zoea described above and the second zoea here described.

It has been possible to get the second zoea metamorphosed in the laboratory into the third zoea stage. A single zoea of the second stage obtained from plankton on January 16, 1952 moulted into the next stage on January 18.

Third zoea (Fig. 28). It measures 5 mm. from end to end of the spines and is 4 mm. in length and is thus much longer than the previous stage. The rostral spine is 1.5 mm. and the posterior spine is 2 mm. long. There are a few very small spines at the postero-lateral margin of the carapace. The thoracic and abdominal appendages are better developed. Only slight changes are observed in the cephalic appendages.

First antenna (Fig. 29) is two jointed. The terminal segment has three groups of long aesthetes. The basal segment is enlarged and has a short flagellum.

Second antenna (Fig. 30) retains the long spiniform process which is only half as long as the rostral spine. The flagellum or the endopodite shows two indistinct segments while the exopodite is short and unsegmented with two terminal setae.

Mandible (Fig. 31) has grown stouter and has irregular teeth.

First maxilla (Fig. 32) has only one plumose seta on the epipodite. The coxopodite is smaller than the basipodite, the former with eight setae and the latter has twelve setae of which only six are spinous. On the small basal segment of the two jointed endopodite there is a single seta and the terminal segment carries five long setae.

Second maxilla (Fig. 33) has seven setae on the coxopodite, ten on the basipodite and six on the endopodite. The scaphognathite is broad and carries twenty-eight plumose setae.

First and second maxillipeds are the same as in the previous stage.

Third maxilliped. Just in front of the cheliped the third maxilliped can be seen still remaining as a rudiment (Fig. 34: 3*m*).

Thoracic appendages are distinctly segmented (Fig. 34).

Abdomen. The lateral spines on the second and third abdominal segments and also the long postero-lateral spines on segments three to five are present. On the dorsal side of the first segment there are three hairs and the other segments have a pair of short dorsal hairs. The pleopods, although rudimentary, show the two jointed nature with a short basal segment and a longer distal one. They are present in segments two to six, the last one being smaller than the others.

The third zoea directly metamorphosed into the megalopa. A zoea obtained on January 11, 1952 metamorphosed in the laboratory into a megalopa on the next day.

Megalopa (Fig. 35) retains the rostral spine. The size of the megalopa may vary and from the tip of the spine to the posterior border of the carapace it measures usually 2 mm. in length and 1 mm. in width across the broadest part. Megalopae ranging in size from 1.9 × 0.9 mm. to 2.25 × 1.25 mm. have been collected from plankton. It often swims about near the surface with the aid of the setose pleopods. The chelipeds and the pereiopods are also fully formed and the latter are used for walking when the megalopa sinks to the bottom.

The carapace has one or sometimes two large median chromatophores, one branching chromatophore on each optic peduncle and a pair of smaller ones on the dorsal side of the first abdominal segment. The third and fifth segments of the pereiopods also have small chromatophores. Like many of the Portunid megalopae this too has two long backwardly pointed spines from the sternal plate of the last thoracic segment (Fig. 36). Delsman and De Man (1925) have said that the spines originate from the basal joint of the last pair of pereiopods. Looking at these spines from the dorsal side one may get the impression that these originate from the last segment of the walking legs but an examination from the ventral side reveals clearly that these are only prolongations of the sternal plate of the last thoracic segment.

First antenna (Fig. 37) has eight segments on the main branch of which the basal one is the largest. The last four segments are relatively smaller and they bear bunches of aesthetes. There is a short flagellum with two terminal aesthetes on the fourth segment.

Second antenna (Fig. 38) consists of a broad basal segment and a long eleven jointed endopodite. The spiniform process of the exopodite of the zoea has completely disappeared.

Mandible (Fig. 39) has a short three jointed palp with its terminal segment bordered by hairy setae.

First maxilla (Fig. 40) is a small piece with three lobes.

Second maxilla (Fig. 41) has the scaphognathite broadened considerably than that of the zoea. Its marginal plumose setae have been replaced by numerous short hairs. The coxo- and basi-podites have been reduced in size with a few terminal setae. The endopodite is narrow and devoid of any setae.

First maxilliped (Fig. 42). The protopodite is produced inwards into a bilobed masticatory process armed with stiff setae. The endopodite is a single flat piece with four marginal setae near the tip. The exopodite is two jointed, the proximal one is long and has three setae while the distal segment is bent at right angles to the first segment and bears three long terminal setae. A long epipodite bearing a few thread-like setae arises from the coxopodite.

Second maxilliped (Fig. 43). Protopoditic segments are small. The coxopodite bears a short epipodite with a single seta, and a gill is also present. Endopodite has five segments the distal three of which are short and bent at right angles to the first two segments. All of them bear a number of setae. The exopodite is two jointed as that of the first maxilliped with four terminal setae on the distal segment.

Third maxilliped (Fig. 44). Protopoditic segments are reduced as in the second maxilliped. The endopodite is five jointed, the first and second segments are flattened and bear a number of setae along the inner margin. The last three segments are bent like the corresponding segments of the second maxilliped and have many setae. Exopodite is two jointed, the second with a few terminal setae. An epipodite and a gill are also present.

Cheliped. In general structure it resembles that of the adult except that the segment next to the chela (carpopodite) has a small recurved spine at its innner border.

Pereiopods. The terminal segments of the last pair of legs are slightly flattened and have a number of long hairs. The other pereiopods almost resemble those of the crab.

Abdomen (Fig. 45). There are six segments and the telson. The first segment is relatively shorter than the rest and has no pleopods. The postero-lateral spines on the pleon-segments three and four have disappeared while those on the fifth segment persist. Segments two to six bear a pair of pleopods. Each pleopod (Fig. 46) consists of a protopodite, a flat exopoditic segment fringed with usually twenty long plumose setae and a short endopodite.

Telson is almost semicircular and entire without spines or setae.

The megalopa moults directly into the first post-larval instar with a flexed abdomen and a broad carapace with two lateral spines.

TABLE I

Details of megalopae reared in the laboratory

Date of capture and size of megalopa (mm.)	Date of moult and size (mm.)				
	I instar	II instar	III instar	IV instar	V instar
28–6–1951 1·10 × 2·00	29–6–1951 2·50 × 2·25	8–7–1951 4·75 × 3·25	12–7–1951 6·00 × 4·50	19–7–1951 7·00 × 5·00	28–7–1951 8·50 × 6·00
18–7–1951 1·15 × 2·00	19–7–1951 3·00 × 2·25	29–7–1951 5·00 × 3·50	—	—	—
18–1–1952 1·10 × 2·00	19–1–1952 2·50 × 2·10	27–1–1952 3·60 × 2·50	—	—	—
18–1–1952 1·10 × 2·00	19–1–1952 2·75 × 2·10	25–1–1952 4·00 × 2·75	—	—	—
18–1–1952 1·10 × 1·90	20–1–1952 2·50 × 2·10	27–1–1952 3·50 × 2·30	—	—	—

Note.—Of the measurements given, the first one refers to the width of carapace and the second the length inclusive of the rostral spine.

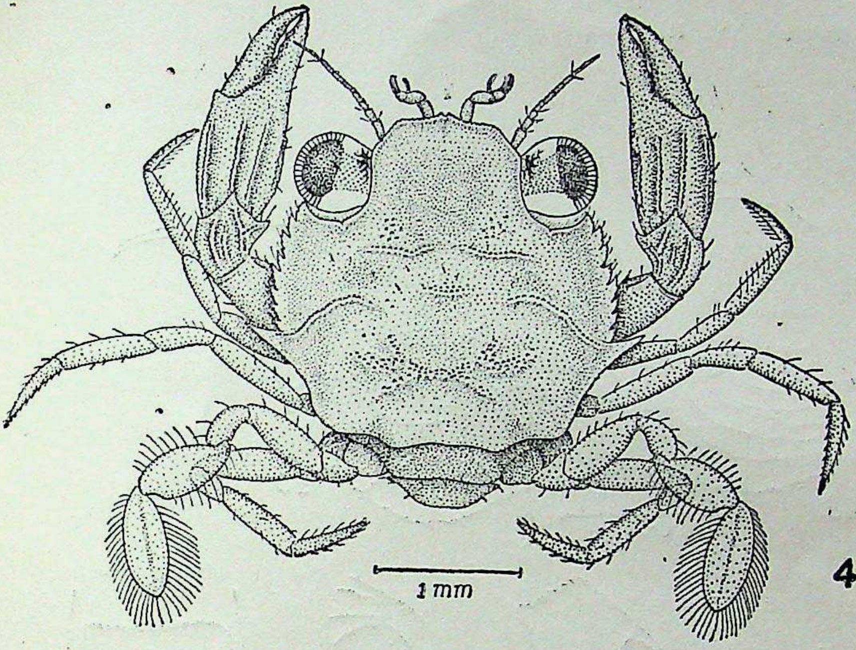
Several megalopae were obtained from plankton collections both from the Gulf of Manaar and the Palk Bay. Some of them moulted during the course of a few hours while most of them took about twenty-four hours to metamorphose. A few remained as megalopae for three days before metamorphosing into the first post-larval instar. A megalopa which was reared from a zoea obtained on January 11, 1952, metamorphosed in the laboratory on the sixth day after becoming the megalopa. The moulting is a quick process and is usually completed in about fifteen minutes as observed in the laboratory. The splitting occurs along the posterior border of the carapace and the entire body is withdrawn from the shell which is cast off and the post-larval instar moves away from it.

Although several attempts were made in rearing these in the laboratory only a few were successful. Table 1 shows the details of megalopae which were successfully reared in the laboratory at least through two successive moults.

First Post-larval Instar (Fig. 47). The surface of the carapace is covered with pigment spots so as to give a dull grey colour which often matches well with the colour of the substratum and perhaps protects the young crab from its enemies. The rostral spine of the megalopa disappears during this metamorphosis. The carapace becomes wider and develops the marginal spines. Those reared in the laboratory measured 2.5 to 3.0 mm. in width and 2.1 to 2.25 mm. in length. It will be seen from the figure that the shape of the carapace at this stage is very much different from the fully grown crab. The proportion of length/width is approximately 1.11 in the first instar. The margin of the carapace between the eyes is nearly entire without teeth. The eyes are now lodged within shallow sockets. The large branching chromatophore on the eye-stalk still persists.

The appendages resemble very much those of the adult. The segments of the first antenna have become shorter, the flagellum of the fourth joint is reduced retaining the bunches of terminal aesthetes. The chela shows slight longitudinal ridges and a few hairs on it. Hairs have also developed particularly on the penultimate and last segment. The last pair of legs have become the swimming legs with flat paddle-like terminal segments as in the adult. The two backwardly directed spines of the last pair of sternal plates have disappeared completely. The abdomen is short with seven segments and fully flexed under the cephalothorax. The first and last segments do not possess any appendages. The flat pleopods of the megalopa which were used for swimming are replaced by slender appendages. The young crab remains at the bottom and seldom comes up to the surface.

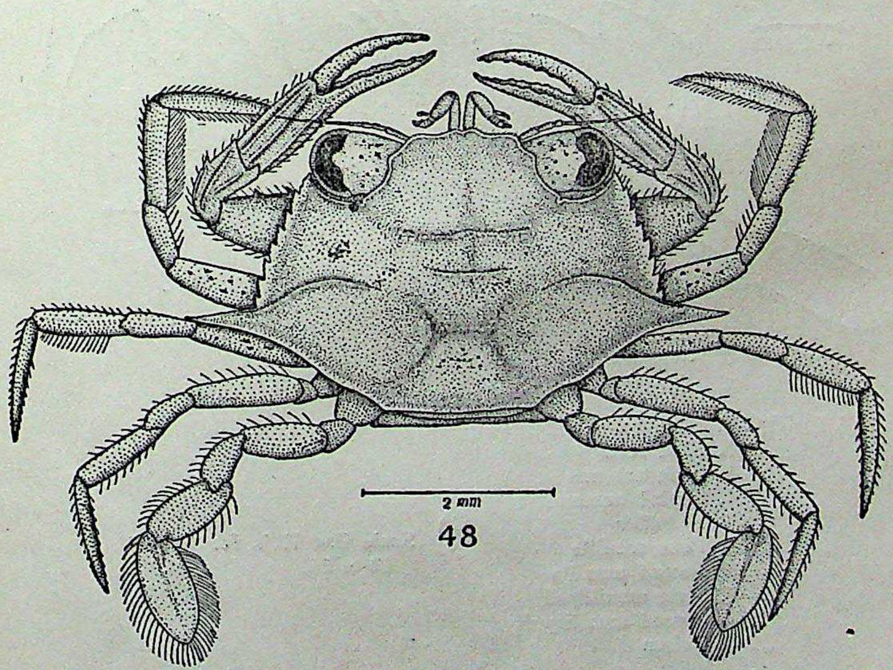
Second Post-larval Instar (Fig. 48). Under laboratory conditions it has been observed that the time taken for the first instar to moult into the second instar may vary from six to ten days. Considerable variation in the size at this stage has been observed in those reared in the laboratory (Table 1). The length/width proportion ranges from 0.65 to 0.70 and this proportion approximates more that of the adult than the first instar. The teeth on the anterior margin of the carapace between the eyes present in the adult are indicated by blunt projections. The large chromatophores on the eye stalk has broken up into small stellate ones. Small pigment spots are present uniformly all over the carapace and chelipeds. The young ones have now practically assumed most of the characters of the adult except for the colour and the shape of the carapace which they attain only after a series of successive moults. Photo 6 shows a juvenile 8.5 mm. in carapace width during the process of moulting.



47

Neptunus pelagicus

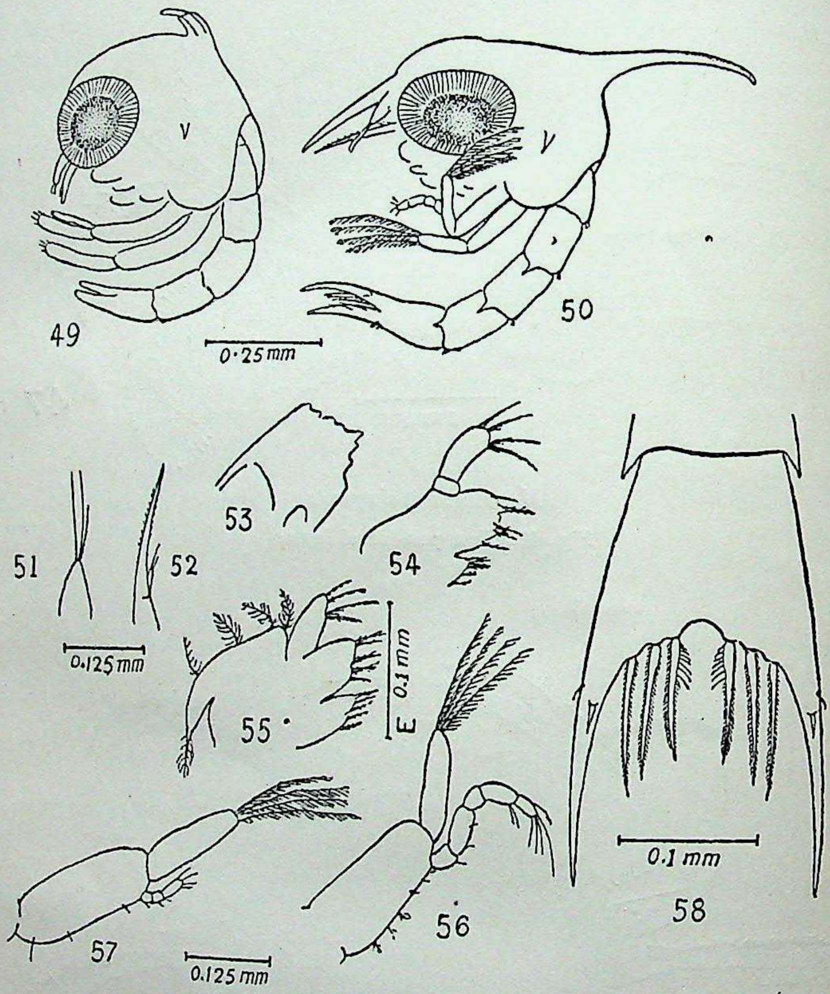
Fig. 47. First post-larval instar



48

Neptunus pelagicus

Fig. 48. Second post-larval instar


49
50
0·25 mm
51
52
0.125 mm
53
54
55
E 0.1 mm
56
57
0.125 mm
58
0.1 mm

Thalamita crenata

Fig. 49. Pre-zoea
,, 50. First zoea
,, 51. First antenna
,, 52. Second antenna
,, 53. Mandible
,, 54. First maxilla
,, 55. Second maxilla
,, 56. First maxilliped
,, 57. Second maxilliped
,, 58. Telson

Scale line E is for figures 53 to 55.

GENERAL REMARKS

Along with the study of the biology of *N. pelagicus* the authors maintained records of the size frequency of crabs landed at Vedalai for 1950 and 1952 in order to ascertain the relative proportion of different sizes caught. During 1950 the majority of the males landed varied from 120 to 143 mm., whereas in 1952 the males landed were slightly larger, 125 to 149 mm. As for the females in 1950 as well as 1952 the landings included apparently two age groups. In both the years the modes fall at almost the same size groups (Fig. 1). Studies on the biology have indicated that the males attain maturity when they are about 102 mm. and the females 106 to 108 mm. Although the females mature at 106-108 mm. majority of the ovigerous famales caught are between 115 to 159 mm. (Fig. 3). This may mean that many of the females marketed now (Fig. 1) would not have had a chance to mate before they are captured. The position regarding the males is different. Majority of the males now landed are sufficiently grown up to be marketed.

It may be pointed out that if the industry expands the first step towards legislation will have to be the protection of berried crabs and then extend that to all females. Subsequently other legislative measures such as size limit on males and closed season *et cetera* may be enforced if found necessary. In this connection it may be mentioned that a certain amount of damage to the juveniles is caused by the use of 'konda valai'. As already mentioned elsewhere in this report very small crabs, sometimes in large numbers, are caught in the 'konda valai'. They are too small to be used for food and so the fishermen leave them on the beach where they die. This is a practice which should be discouraged. It is also necessary to take into consideration the use of bottom nets such as 'nandu valai'. This method, though efficient in catching crabs does not seem to be good because of the excessive handling of the crabs and consequent injury to those small ones and the females which are to be put back into the sea. Further detailed investigations on the population strength, intensity of fishing, rate of growth, rate of recruitment and other allied problems will have to be carried out at different centres before finally framing legislative measures.

NOTE ON THE ZOEA OF *Thalamita crenata*

While examining the plankton for the zoea of *N. pelagicus*, the authors encountered several zoeae closely resembling those of *N. pelagicus*. Attempts were made to ascertain the identity of these zoeae. On January 18, 1952 a specimen of *Thalamita crenata* with yellowish brown eggs was obtained. It was kept in the aquarium and the eggs hatched on the 24th. These zoeae turned out to be the ones referred to above. As these are very much like the zoeae of *N. pelagicus* it was deemed necessary to add a brief note pointing out the salient features.

The freshly spawned eggs are yellowish brown in colour and measure on an average 320 micra in diameter. As development progresses the 'berry' changes its colour from yellowish brown to brownish black.

Pre-zoea (Fig. 49). The eggs hatch out as the pre-zoeae. All the spines are telescopic but are shorter than those of the corresponding stage of *N. pelagicus*. The thoracic appendages have their setae retracted and the forks of the telson are not fully extended. The embryonic cuticle is cast off by the pre-zoea in a short time and it develops gradually the characters of the fully developed first zoea.

First zoea (Fig. 50). The rostral spine is 0.23 mm. and the posterior spine, which has a curved tip, is 0.275 mm. in length.

First antenna (Fig. 51) is single jointed and bears three terminal aesthetes.

Second antenna (Fig. 52). The spiniform process which is about the length of the rostral spine has fewer spines than in the corresponding zoea stage of *N. pelagicus*. The flagellum is absent at this stage.

Mandible (Fig. 53) is a short piece with irregular teeth.

First maxilla (Fig. 54). No epipodital hair. The coxopodite bears six setose spines, whereas the basipodite has five of which one is a simple spine. The endopodite is two jointed and the distal segment has six setae.

Second maxilla (Fig. 55) has five and eight spinous setae on the coxopodite and basipodite respectively while the endopodite bears only four setae. The scaphognathite has five plumose setae along its margin.

First and second maxillipeds (Figs. 56 and 57) have the same structure as those of the first zoea of *N. pelagicus*.

Abdomen has five segments and the telson. A pair of short dorsal hairs are present on all the segments. Segments two and three have a pair of short lateral spines. Postero-lateral spines are present on segments three to five.

Telson (Fig. 58) is deeply forked. In size and general shape it is different from that of the zoea of *N. pelagicus*. As can be seen from the Figures 18 and 58 the position of the lateral and dorsal spines on the forks of the telson is different in the two species. The spines between the forks are more or less similar in both.

The zoea of *Thalamita crenata* thus shows striking similarities but can be distinguished from that of *N. pelagicus* by the differences mentioned above.

SUMMARY

1. The habits and habitat of *N. pelagicus* have been briefly described. Segregation according to size has been noticed. There is a greater proportion of males in the catches which may indicate schooling according to sex. There is apparently no such segregation by sex among the smaller ones.

2. Observations made suggest that the breeding season in the species is protracted but the maximum breeding takes place during September to March.

3. The species exhibits marked sexual dimorphism. The females attain maturity when they are 106 to 108 mm. across the carapace. The males seem to mature at a smaller size.

4. The eggs and the various developmental stages up to the second post-larval instar have been described from larvae reared in the laboratory as well as from those obtained in the plankton.

5. The larvae hatch as the pre-zoea and pass through three zoeal stages before becoming the megalopa. The megalopa moults directly into the first post-larval instar. At this stage they take to a bottom life.

6. A brief description of the zoea of *Thalamita crenata,* another common Portunid occurring in this area, has been given.

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POPULATIONS OF MRS. GOULD'S SUNBIRD,

WITH COMMENTS ON RANGES AND VARIATION AMONG RELATED SPECIES OF SUNBIRDS

BY

S. DILLON RIPLEY

Mrs. Gould's Sunbird, *Aethopyga gouldiae,* is one of the most beautiful of that brilliant tribe. The typical *gouldiae* of the Himalayas has a metallic purplish-iridescent crown reaching back to the nape, metallic patches on the posterior ear coverts, throat, and a patch high up on the side of the jugulum. The back and wing coverts are rich red, the rump yellow, while the upper tail coverts and the two central tail feathers for more than half their length are a metallic bluish color.

Below, typical *gouldiae* has a metallic iridescent throat and a bright lemon-yellow breast which shades to dull olive-yellow on the lower abdomen and under tail coverts. The sides of the breast are flecked with occasional red feathers, while the center of the breast may or may not, varying in different individuals, have a few flame-red edgings to the yellow feathers.

Dabry's Sunbird, *Aethopyga gouldiae dabryii,* described from Tatsienlu in western Szechuan, was for long thought a separate species. In coloration, however, the sole difference between *dabryii* and *gouldiae* is in the underparts. The tendency to flame-red edgings on the breast feathers seen in *gouldiae* has been intensified so that the whole breast is flame-red with the feathers fading from flame-red to yellow halfway toward the base, but individual feathers may be edged with yellow. Yellow is more extensive in this form also, extending throughout the lower surface, replacing the olive-yellow of the vent and under tail coverts of *goldiae.*

A third color variant is the subspecies *annamensis* of southern Laos and Annam in Indo-China. In this form the underparts are entirely yellow, and the rump is yellowish-olive instead of yellow. These seem, lacking any recognizable size variations, to be the only differences and form an interesting example of strictly discontinuous variation of alternative characters. These characters might be expressed as follows:—

Y = yellow breast U = olive under tail coverts R = yellow rump
y = red breast u = yellow under tail coverts r = olive rump

Using a combination of these characters as symbols, the subspecies can be listed as follows:—

Aethopyga gouldiae gouldiae = YUR
" " *dabryii* = yuR
" " *annamensis* = Yur

Thus two characters vary independently in each of these three populations.

THE SOUTHERN ASSAM POPULATION

In a paper on the birds collected by my wife and myself in the Naga Hills (1952), I discussed these little sunbirds in the eastern

Naga Hills near the Burma border, and came to the conclusion that one of the immature males we collected was a hybrid between *gouldiae* and *dabryii.* I resurrected the name *isolata* Baker for what seemed to be a hybrid population based on this specimen and on Stuart Baker's reference to red-chested birds seen in North Cachar (1926). In order to re-examine this situation I have borrowed a total of 81 male specimens of this species in addition to material in the Peabody Museum. I am most grateful to the authorities of the British Museum, the Harvard Museum of Comparative Zoology, the American Museum of Natural History and the U.S. National Museum for the loan of these specimens.

Besides my immature bird from the eastern Naga Hills, there are two puzzling references in the literature to the distribution of the species in southern Assam. One is Hume's account in the Birds of Manipur (1888). The author reports a sight record of the flame-red breasted *dabryii* at the top of Hendang Peak in the eastern hills near the Burma border. The description is accurate and detailed, and I am inclined to credit it, although it is only a sight record. Nearby at Aimole and Machi, Hume collected typical *gouldiae.* Unfortunately he does not record the time of year.

The second reference is in Baker (op. cit.). In this he states that he collected females of *dabryii* in north Cachar on the nest. Males were seen but not collected which, *vide* Baker, had 'far deeper flame-red breasts than the ordinary *g. gouldiae.*' Unfortunately the females are in the Museum at Sophia and I have not examined them. However, on reconsideration of this statement of Baker's (which inclined me previously to believe that the *dabryii* phenotype might thus be cropping up occasionally in this area), I am inclined to doubt his record. Baker described *isolata* (1925), the population from southern Assam south of the Brahmaputra River, as having a pure yellow breast without the occasional red edgings found in typical *gouldiae.* He relates that on Mount Victoria, the yellow-breasted *isolata* occurs at 5,000 ft., while at 6,000 ft. all the birds were 'red-breasted'. As Stresemann (1940) has shown, nothing but *gouldiae*-type birds occur on Mount Victoria, and I believe that Smythies's (1940) listing of *dabryii* from Mount Victoria is simply a direct quotation from Baker (op. cit.). The presence or absence of red edgings to the breast feathers is individual and not a racial character. I have examined heavily red-edged birds from south of the Brahmaputra, and certainly on the basis of this supposed character, *isolata* could never stand. Furthermore, Hume (op. cit.) notes that *dabryii* has a yellow abdomen below the red breast and presumably this includes his sight record. As this added difference in the two forms seems to have escaped Baker entirely (op. cit.), I am inclined to accept Hume's sight record, and to reject Baker's. The females are unlikely to prove to be diagnostic as there is considerable variation in the whiteness of the tips of the tail feathers among the various populations.

Among our series from the eastern Naga Hills was one subadult male which had a patch of red feathers growing in on the breast in an asymmetrical manner. This specimen was taken along the trail which runs east from Kohima towards the Chindwin and Burma. The spot was 75 miles east by the trail, while 2 miles short, near the 73-mile mark we had collected adults of typical *gouldiae.* It did not seem at the time that we could actually have come to the borderline

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between two subspecies. No geographical or ecological barrier exists at this point in these uniformly tumbled, scrub-covered hills. However, subsequent study has convinced me that these specimens do mark two distinct subspecies and that this is their boundary zone, unless the *dabryii* record is simply a winter visitor.

IMMATURE PLUMAGES

Some description of the immature, male plumages examined may be of interest here. I agree with Deignan (1945) that there is no indication of an eclipse plumage in this species. This point is worth noting as the suggestion had been made by Delacour and Greenway (1940) that perhaps the species *gouldiae* has an eclipse plumage as has *ignicauda*.

(1) The earliest taken subadult male I have examined is a male of typical *gouldiae* collected in October at Mussoorie, U.P. This bird has one all-red feather on the upper right side of the mantle, one or two on the sides of the breast and suffusion of rich orange-yellow coming in on the sides of the rump and belly. One of the central tail feathers has a metallic iridescent edging as have several of the upper tail coverts.

(2) Another subadult of December 2, from the Naga Hills, has two metallic feathers on the crown and several on the throat, with numerous red feathers on the mantle and upper wing coverts. The tail and upper tail coverts seem to be complete as in the adult. The breast is pure yellow.

(3) The immature previously referred to from 75 miles east of Kohima collected December 3, 1952, which I now believe to represent the first collected record of *dabryii* from Assam, has one metallic feather on the crown and numerous red feathers on the sides of the mantle and on the greater and lesser wing coverts. The rump is rich yellow. The metallic upper tail coverts are present, but the tail is still dull colored and white tipped as in the female plumage. The breast and abdomen are yellow with irregular splashes of red. The lower abdomen and under tail coverts are yellowish-olive as in the female.

(4) A January subadult of *dabryii* from Mount Muleyit in Tenasserim has the crown still gray but edged with metallic feathers, the mantle red except the nape. The tail feathers are short. The throat is gray with a median metallic streak and patches on the sides. The ear coverts are black. The breast is already completely red.

(5) A young male *dabryii* from Thailand taken in March has a gray crown and nape. The median streak of metallic feathers on the throat is broad and heavy. The breast is red. The posterior ear coverts are commencing to have metallic feathers.

(6) A bird from Mount Angka in Thailand which has been sexed as a '♀?' taken in March, has a sprinkling of red *edgings* to the feathers of rich olive colored crown. There are similarly red-edged feathers on the mantle and one or two on the throat. There are no traces of metallic feathers. It seems entirely possible that this specimen (M.C.Z., No. 197013) is in fact an old female which is assuming partial male plumage.

From the above evidence it would appear that young males of the year in this species assume nuptial plumage gradually and somewhat irregularly over a period of at least seven and possibly ten months.

THE NAME OF THE SOUTHERN ASSAM POPULATION

I have compared 16 adult males of *gouldiae* from south of the Brahmaputra River with 17 adult males from the Himalayas, and am convinced that Baker's name, *isolata,* must be upheld. This population does not differ from nominate *gouldiae* in color as Stresemann (op. cit.) has already noted. In general it may be said that there is a tendency to a purer lemon yellow coloring on the breast, less often flecked with red edgings, but individuals may be heavily flecked. However, in size, this population is definitely smaller, as follows:—

		Wing range in mm.	Mean	σ
g. gouldiae	16 ♂♂	53·5–58	56·06	± 1·38
g. isolata	17 ♂♂	50–56·5	53·43	± 1·88

When tested by the formula of t for small samples, it is found that the difference between the means is significant ($P > .001$).

Therefore, I believe that the name, *isolata,* should stand for this population, and that I was mistaken in ascribing this name to a hybrid complex. However, in its range, this form apparently comes into direct contact with *dabryii* in the eastern Naga Hills, and possibly in eastern Manipur.

RANGE OF THE SPECIES

I would accordingly list the following forms of *Aethopyga gouldiae*:

(*a*) *gouldiae*. Range: India in the western Himalayas (Sutlej Valley, *vide* Baker) up to 12,000 ft. in the deciduous and coniferous zone and to the hills north of the Brahmaputra River. Forested areas of south-east Tibet, apparently migrating south in the depths of winter.

(*b*) *isolata*. Range: Assam south of the Brahmaputra in north Cachar, the Naga Hills at least as far east as Meluri, 73 miles east of Kohima (by trail), Manipur in the hills as far east as Aimole and Machi, south through the Lushai Hills and Tripura to East Pakistan in the Tipperah and Chittagong Hills. Burma in the Chin Hills (Mount Victoria) and south to the Arakan Yomas. An inhabitant of scrub and deciduous forest up to about 7,500 ft.

(*c*) *dabryii*. Range: Assam in extreme eastern Naga Hills (specimen taken 75 miles east of Kohima by trail), and eastern Manipur (sight record?). Both of these records may, of course, be winter visitors. Burma (except in the Chin Hills and Arakan Yomas), from the Chindwin and north Burma south through the Shan States to Tenasserim, Thailand, northern Indo-China in Laos and Tonkin, and China in Yunnan, Szechuan and western Hupeh. Deignan (op. cit.) maintains that all Thailand records are for wintering birds taken between November 4th and March 18th and further asserts (1944) that records for Indo-China presumably refer to winter visitors. The species is not known to breed in Burma, but has been taken as late as April in the north-west. It is found in deciduous and coniferous forest up to at least 11,000 ft. I agree with Deignan that *bangsi* and *harrietae* are synonyms.

(*d*) *annamensis*. Range: southern Laos and Annam in the Langbian and Bolovens areas in southern Indo-China.

SEASONAL WANDERING

During November-December in the Naga Hills at 4,000-5,000 ft., we found four species of *Aethopyga* in the same flowering trees in open scrub. These were *saturata*, *siparaja*, *nipalensis*, and *gouldiae*. A fifth species, *ignicauda*, was taken at this altitude and near by, but only in open pasture land. There is a considerable amount of indicated overlap between these species and the problem of potential competition between them still needs to be worked out. A partial indication of their ranges may be given as follows:—

WINTER

open scrub and pasture land ——→ evergreen forest

	1–3*	3–4	4–4·5	4·5–5	5–8	8+
nipalensis				×	×	×
saturata		×	×	×		
siparaja	×	×	×	×		
ignicauda				×	×	×
gouldiae			×	×	?	

SUMMER

Scrub jungle ——→ evergreen forest ——→ deciduous and coniferous

	1–3	3–4·5	4·5–5	5–7·5	7·5–8	8+	10+
nipalensis ...				× (Assam)	×	×	
saturata ...		×	×	×			
siparaja ...	×	×	×	× (Yunnan)			
ignicauda ...				×	×	×	×
gouldiae ...					×	×	×

GEOGRAPHICAL VARIATION AMONG SUNBIRD SPECIES

It is perhaps worth pointing out that some of these species of sunbirds seem to vary in a parallel way, breaking up into subspecies from west to east through a common geographical range. Ticehurst (1938) has noted the remarkable similarity of variation in two virtually similar species of Laughing-thrush in this same general area. In these sunbirds, the species are in no sense sibling species, although they are obviously all related fairly closely to each other. Nor are the divisions into geographical races in any sense exact. However, there is an interesting parallelism in the pigment change among them as follows:—

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* (thousands of feet altitude.)

Indian Subregion, Assam through Indochinese Subregion, west to east

Olive or yellow	→ Increased yellow or red —	→ Red —	→ Yellow or olive, or darker
A. nipalensis →	→ *koelzi* → *victoriae* →	→ *angkanensis* - →	→ *karenensis*
			↘ *blanci—ezrai*
A. saturata →	*assamensis* → *sanguinipectus* → *petersi* → *ochra* →	→ *johnsi*	
A. siparaja seheriae →	→ *labecula* —	—	→ *mangini*
A. gouldiae →	→ *isolata* —	→ *dabryii* —	→ *assamensis*

SUMMARY

Aethopyga gouldiae has four recognizable subspecies distributed from the Himalayas through the Indochinese Subregion. One subspecies, *isolata*, is recognizable on size measurements. Another, *dabryii*, must now be included within the fauna of the Indian Union. Some comments on ranges and color variations among *gouldiae* and related species are also included.

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A NEW SPECIES OF *SESAMUM*

BY

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(*With two plates*)

In India the family Pedaliaceae consists of two genera *Pedalium* and *Sesamum*. The genus *Sesamum* has three species. (1) *S. indicum* Linn., (2) *S. laciniatum* Klein, (3) *S. prostratum* Retz. The author in his collection tour came across plants resembling the cultivated gingely plant near Stuartpuram, a village near Bapatla. The plant differs from the other three species in the nature of its seeds, capsule and leaves. It has been created into a new species and named after the late Dr. T. Ekambaram, Professor of Botany, Presidency College, Madras.

Sesamum ekambaramii Naidu, species nov.

The main distinguishing characters of this species are winged seeds, palmately compound leaves and long beaked capsule which is broader at the top and narrowed towards the base. Whereas the capsule in *S. indicum* is of same width throughout and the capsules in the remaining two species are ovoid and compressed, the seeds being wingless in all the three species. *Stem* erect, simple or branched, angular with worty protuberances, height varies from 1 to 6 feet. *Leaves* palmately compound. The upper ones are simple. Phyllotaxy: opposite at the base and sub-opposite towards the top. The leaflets are linear-lanceolate, entire. Young leaflets mealy glandular below and glaucous above. *Flowers* solitary, axillary, pedicels short, each with two cup-shaped glands on either side. The bigger gland bears a small gland by its side. Glands sessile. *Calyx* 5, free, lanceolate, pubescent sepals. *Corolla* purple coloured, 5 lobed, obliquely campanulate, pubescent, lobes acute, imbricate, base narrow, bears hairs at the narrowed portion of the corolla where the filaments are attached. *Stamens* 4, didynamous, filaments hairy with glandular tips. Introrse, no staminode. Anthers sagittate dorsifixed, connective elongated into a pointed structure. Dehiscence by longitudinal slits. Pollen grains round with thickened bands of 7 to 8 in number. *Ovary* two celled but divided into four cells by a false septum. Ovules many, one seriate in each cell. Style filiform, stigma two lobed. Fruit capsule more than 1 in. long, beaked, broader at the top, narrowed towards the base, tetragonous. Dehisces on both sides along the septa up to $\frac{1}{4}$ in. and further dehiscence continues on one side only. Seeds numerous, black, winged. The wings arranged on two sides. Testa muriculate and foveolate. Seeds yield oil on pressing.

Sesamum ekambaramii Naidu, spec. nov.

Characteres distinctivi huius speciei sunt semina alata, folia palmate composita, capsula longe rostrata; capsula vero latior est in apice et angustata ad basim. *Sesami indici* vero capsula est uniformiter lata, capsula in caeteris speciebus est ovoidea atque compressa, semina vero haud alata in his tribus speciebus.

Caulis erectus, simplex vel ramosus, angularis, verrucosus, semel ad sixies pedalis. *Folia* palmate composita; superiora quidem simplicia; omnia opposita ad basim, sub-opposita supra ad apicem. Foliola lineari-lanceolata, integra. Noviuscula foliola farinaceo-glandularia infra, glauca supra. Flores solitarii, axillares, pediculis brevibus atque insignitis duplici cyathiformi glandula in utroque latere; glandula maior ornata est glandula minore ad latus. Glandulae sessiles. Calycis sepala 5, libera, lanceolata, pubescentia. Corolla purpurea, 5-lobata, oblique campanulata, pubescens, lobis acutis, imbricatis, basi angusta, corolla pilosa ad partem angustam ubi filamenta infiguntur. Stamina 4, didynama; filamenta pilosa apicibus glanduliferis; antherae introrsae; staminodia nulla. Antherae sagittatae, dorsifixae, connectivo elongato in structuram acutam. Antherae dehiscent per scissuras longitudinales. Pollinis grana rotunda, ornata 7-8 crassis vittis. Ovarium 2-cellulatum, sed divisum in 4 cellulas per septum falsum; ovula plurima, semel seriata in singulis cellulis; stylus filiformis, stigma bilobatum. Fructus capsularis, longius uno pollice, rostratus, latior in apice, angustus ad basim, tetragonus, dehiscens in utroque latere ad septa usque ad quartam pollicis partem, dehiscentia continuata in uno latere tantum. Semina plurima, nigra, alata; alae in utroque latere seminum; testa muriculata atque foveolata. Expressa semina oleum cedunt.

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EXPLANATION OF PLATE II

Fig. 1. Complete plant—diagrammatic representation.
,, 1. (*a*) Flower.
,, 2. Front view of the flower.
,, 3. L.S. of flower.
,, 4. Calyx.
,, 5. Anthers.
,, 6. Pollen grain.
,, 7. Corolla cut open.
,, 8. T.S. of Ovary.
,, 9. Pistil.
,, 10. Stigma.
,, 11. Fruit.
,, 12. Seed with wings.

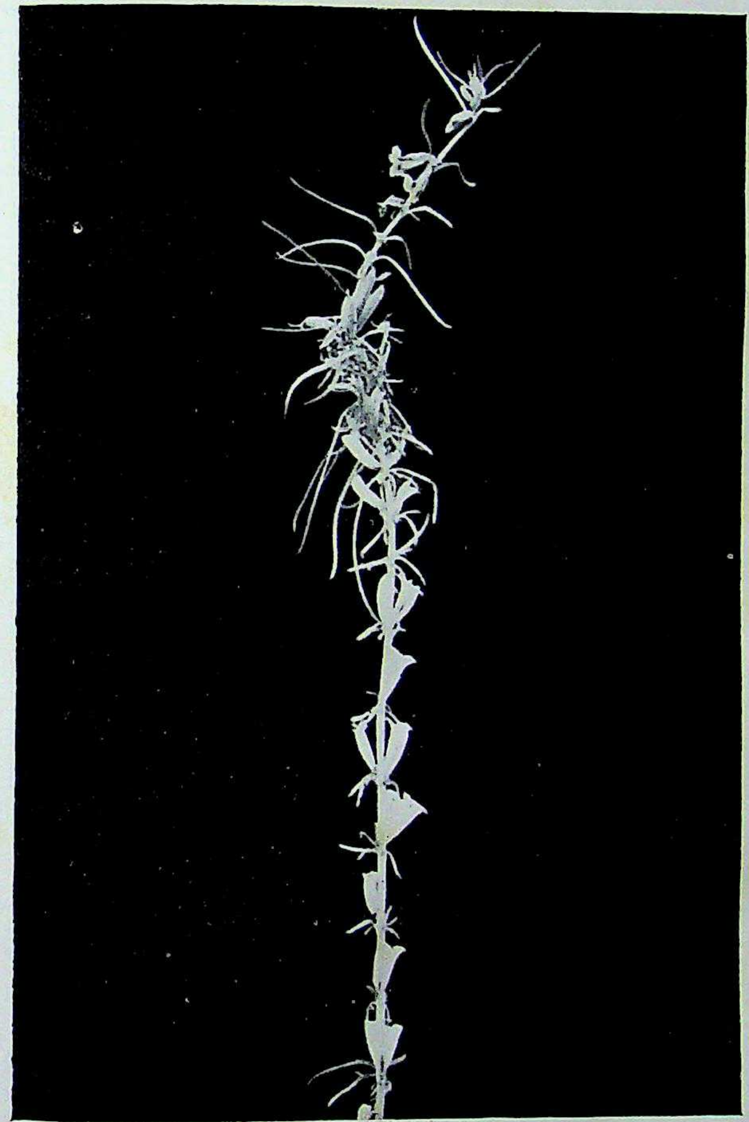
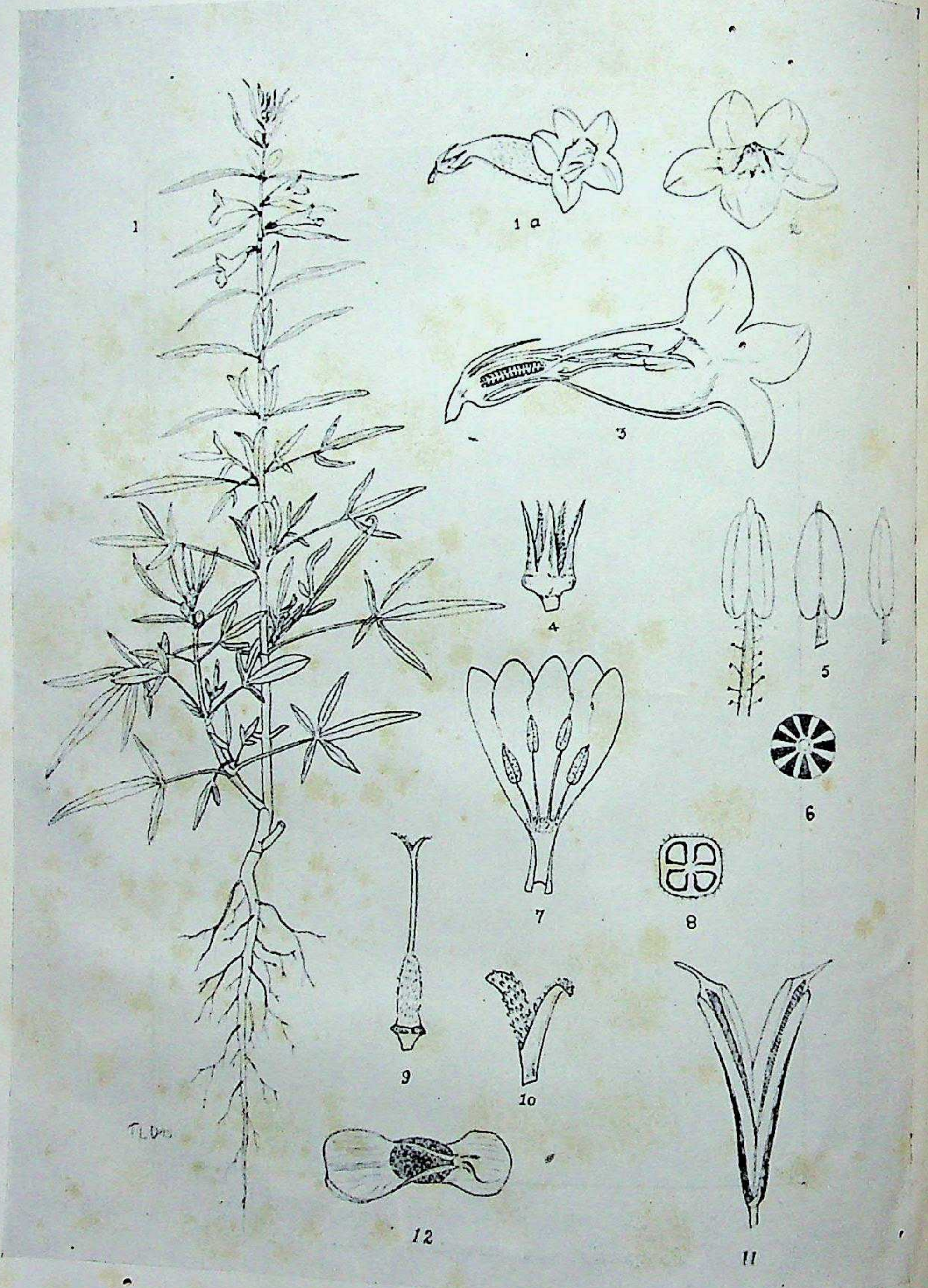


Fig. 1. *Sesamum ekambaramii* Naidu, spec. nov.

Top portion of shoot with flowers and fruit.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Sesamum ekambaramii Naidu, spec. nov.
Figs. 1–12 : Explanation at end of article

SECONDARY SONG OF SOME INDIAN BIRDS

BY

M. D. LISTER

INTRODUCTION

It seems to be generally agreed among ornithologists that the repeated loud song of birds, which is such a distinctive characteristic of the arrival of spring in temperate regions, is connected with and forms a definite part of the birds' annual breeding cycle. Eliot Howard (1920) suggested, when advancing his well-known 'territory theory' that this loud, persistent song was part of the regular procedure for acquiring and maintaining a 'territory' in which to breed and from which to obtain food for the sustenance of the family. While this idea is probably basically sound, various later writers [e.g., Nicholson (1927), Selous (1933)] have suggested modifications of the territory theory as a whole, and the matter cannot yet be regarded as settled.

It has long been recognised that apart from the loud 'territorial' song, many birds have other songs (as distinct from call notes), which from the quality of the song itself, its infrequency, or the circumstances in which it is given may be regarded as of a secondary nature and of less importance than the territorial or primary song. Surprisingly few writers have referred to this secondary song in its various forms, and as yet the subject has not received the close study it deserves.

Secondary song appears to fall naturally into the following main types, though it may well be that further research will show that modification of this analysis is necessary.

1. Autumn and winter song: In some species a recrudescence of song is noticeable after the breeding season is over and the youngsters are fledged. This is probably distinguishable from the primary territorial song in its purpose, which is not yet fully understood, in its loudness and in its persistency, apart from its quality. Lack (1943) when writing on Robins (*Erithacus rubecula*) suggests that the autumn song probably has survival value in teaching the young cocks the specific song.

2. Female song: In the majority of species, so far as is at present known, the hen bird has no song comparable with the primary song of the cock. I do not know whether female song has been noticed in any Indian birds, but it has been observed in a few European and American species.

3. Rehearsed Song of Young Birds: A good deal has been written about the means by which young birds are able on or before reaching maturity to reproduce the typical primary song of the species. Explanations put forward at one time or another vary from pure 'instinct', to environment and example, and to plain trial

and error. Whatever be the truth of the matter—and it may well contain more than one of these ingredients—young birds may often be heard giving a form of song which differs very considerably from the typical loud specific song. In England, to give only two examples, I have on several occasions heard young Blackbirds (*Turdus merula*) and Chaffinches (*Fringilla coelebs*) give songs of this type. [Lister (1940)].

4. Ultra-quiet Song: I believe that Nicholson (1927) was the first ornithologist to recognise what he termed 'Subsong' and described as being 'low and inward, often becoming so faint as to be inaudible at a few yards' range'. The very quietness of this type of song must cause it to be often overlooked, and it is undoubtedly given very much more often than is generally recognised.

There has hitherto been a certain amount of confusion in the terminology applied to this ultra-quiet song and I have recently (1953) put forward a plea for the use of a uniform terminology to assist in further research in this difficult and fascinating subject. There appear to be two general types of ultra-quiet song for which I have suggested the following terms: (a) *Whispering Song*: which is merely a miniature edition of the normal loud territorial or primary song; and (b) *Subsong*: which differs intrinsically from the normal loud territorial song in being very much more of a free, random, *sotto voce* warbling in which other recognised notes are sometimes interspersed.

The functional interpretation of these very quiet songs remains to be worked out. Special songs (e.g., threat, display or courtship songs, etc.) may perhaps fall within the category of Whispering Song or Subsong in different species; until we know more about them we cannot lay down any rules. Apart from such special songs there appears to be a sort of residuum of ultra-quiet song, often given when the singer is alone, and much more evidence is needed before the function of even this can be interpreted with certainty. I have heard both Whispering Song and Subsong in most months of the year, especially among some of the *Turdidae*, and I suspect that most true song-birds indulge in one or both at one time or another.

The following records of secondary song were obtained by me during the war in 1942-45, hence their fragmentary nature.

Chloropsis (? *Chloropsis hardwickii*)

21 October, 1944. Darjeeling. A chloropsis which I believe was of this species was in some light tree jungle with low undergrowth at about 4,500′. After spending some minutes preening itself, it began to forage and at the same time to give a very varied succession of notes, starting with a low warbling song. I was unable to attempt any phonetic record.

? Whitebrowed Shortwing (*Heteroxenicus cruralis*)

25 April, 1945. Darjeeling. I never identified these birds with absolute certainty and I therefore give a short description below in case a more experienced observer can recognise them. They had a rather thin, very high-pitched 'song' of two notes, the second being

pitched about a quarter tone lower than the first, which had considerable carrying power and was given again and again. In addition, the male frequently gave a broken succession of very soft, very high-pitched notes in no recognisable pattern—just a broken, inconsequential rambling *seei . . . sree . . . sree-ee,* each note usually rising. This seemed to me to have much more the character of a song than of call notes.

The male was entirely deep indigo blue, though I believe more blue-grey on the underparts, and in some lights the blue of the fore-crown looked lighter and brighter. A suspicion of a black mark near the eye. I could never decide whether or not there was a faint white eye-stripe. The general colour of the female was tawny olive-brown, rather greyer on the head. Most of my views were from above, among fairly dense bushes where the light was poor. These birds were quite plentiful on the tea garden where this observation was made.

Pied Bushchat (*Saxicola caprata*)

22 December, 1942. New Delhi. One was singing at intervals from a thin thorn bush. It was tame and allowed me to stand only 4-5 yds. away. The song was given softly, audible clearly 4-5 yds. away, but I doubt whether it could have been heard in detail more than 10-12 yds. away. The bird would sing for perhaps a minute, then remain silent on its perch for 2-3 minutes, then give another bout of song, and so on. The song was not unlike that of a Black Redstart (*Phoenicurus ochrurus*), interspersed with various myna-like grating notes, the basis being a *p'teraretyuawei . . . trri-trri.*

Brown Rock Chat (*Cercomela fusca*)

16 October, 1942. New Delhi. One came to a large alcove terrace in the Secretariat building and perched, singing quietly, on the balustrade for some minutes, wagging its tail up and down and occasionally bending its legs and giving a little bob with its whole body. The song was very quiet, probably audible not more than 15 yds. away, and was very like the subsong of the English Robin (*Erithacus rubecula*). The general effect was a lazy, careless, carefree warbling, well leavened with sweet notes. The result was pleasing and the bird seemed to enjoy it too. The throat frequently swelled during the song.

Bluefronted Redstart (*Phoenicurus frontalis*)

25 February, 1943. Darjeeling. One bird I was watching gave a low, warbling song, much less wheezy than the usual song of a Black Redstart (*Phoenicurus ochrurus*), and quiet—almost inaudible 10 yds. away.

Magpie Robin (*Copsychus saularis*)

25 July, 1943. Jessore, Bengal. One sang very softly for 2-3 minutes almost without a pause from an inner branch of a tree. This song was a good deal more rambling than the normal loud song of this species, and it reminded me strongly of the subsong of

an English Robin (*Erithacus rubecula*), though it was not nearly so quiet as some subsongs I have heard. This song was audible clearly 10 ft. away, though it would have been difficult to distinguish 20 ft. away. The bird moved very little during the performance.

14 December, 1943. Jessore. On two or three occasions during the preceding few days I heard Magpie Robins giving a low, sweet subsong, which seemed to me rather more varied than the usual primary song and again reminded me of the subsong of the English Robin.

12 August, 1944. Jessore. One was singing quietly from a bushy tree. The song went rambling quietly on for minutes on end with hardly a break. A few mornings before there had been gentle rain for several hours, and the same bird then sang continuously and softly for quite a long period. The song was very quiet and did not obtrude itself on one's attention like the louder territorial song of the species, and it went rambling on and on. The whole performance was very similar indeed to the behaviour of an English Robin under similar conditions. This song was, I think, not quite soft enough to be called a true subsong, if loudness or quietness are the only criterion; it was audible quite easily 20 yds. away, but it was much more fluid, less definitely phrased than the normal loud song, in fact the phraseology, timbre, and everything about it might have belonged to an English bird.

30 August, 1944. Jessore. At 07.00 hours it was drizzling and a Magpie Robin was singing very quietly in the lower branches of a tree, and opposite, on the other side of the road, another Robin was singing just as softly. They must have been able to hear each other's song without difficulty, but there seemed to be no question of singing against one another as there is with the loud territorial song. The songs of these two birds was again very similar to the subdued subsong of the English Robin in quality, timbre and loudness.

On another morning a few days earlier there was a continuous drizzle and one of the birds that was usually to be seen near my bungalow was singing very quietly for some considerable time.

Greywinged Blackbird (*Turdus boulboul*)

24 February, 1943. Darjeeling. One sang softly for a few minutes in the morning and the song was very similar to that of the English Blackbird (*Turdus merula*).

20 May, 1943. Darjeeling. Immediately after giving the usual loud song of four clear notes in descending scale, a bird gave a low warbling subsong, lasting only a few seconds with a slight pause in the middle. Again it was not unlike the subsong of an English Blackbird, but less rounded and 'finished', and rather flatter and more insipid.

Blueheaded Rock Thrush (*Monticola cinclorhyncha*)

29 May, 1945. Darjeeling. One was singing from the branch of a Siris tree. Between bursts of the normal loud song the bird also gave several other much softer notes, audible where I was standing some 50 yds. away and 100 ft. above. As far as I could tell, these notes were exactly similar to the ordinary loud notes,

but they were much softer and were not flung out with such abandon for all the world to hear. At the same time, while clearly differing from the loud primary song, these notes were not soft enough to be classed as subsong, though they certainly seemed to be of a secondary nature.

Himalayan Whistling Thrush (*Myiophoneus coeruleus*)

21 October, 1944. Darjeeling. One gave a long, low, rambling subsong from near the top of a large *Cryptomeria* tree, for at least 10-15 minutes. This song was very quiet, though distinctly audible 15 yds. away, and consisted of a rambling series of whistling notes, like a quiet but much more varied edition of the ordinary song, sometimes given as independent individual notes, sometimes as phrases. Every so often this subsong was punctuated by a most extraordinary series of spluttering noises, something like the sound produced by pressing one's lips to the back of one's hand and blowing hard—what is known to schoolboys as a 'raspberry', in fact, but much more sustained and long drawn out.

24 October, 1944. Darjeeling. The usual bird was singing from near the top of the same *Cryptomeria* tree. This time the subsong, which alone was given, seemed more unlike the true song than before and much more like the rambling, warbling subsong of an English Robin (*Erithacus rubecula*). Just now and again soft whistling phrases of the usual loud song were given, but these were infrequent. The low spluttering notes were also given occasionally, but this time they were not so much in evidence.

Earlier the same afternoon I had heard another bird singing among some bamboos in a small ravine. This song was soft, though louder than the song mentioned above, and consisted of a quiet edition of the usual whistling song, interspersed now and then with the low guttural spluttering notes. Occasionally the whistling would tail off into a kind of shapeless warbling.

[?] Little Pied Flycatcher (*Muscicapula melanoleuca*)

26 October, 1944. Darjeeling. A 'family' of 8-10 was among a very large mixed hunting party of small birds foraging in a few trees and dense bushes in a large ravine at about 4,500 ft. I watched one of these birds at close quarters. It made only few sorties outside the canopy of the tree and seemed to get most of its food in fluttering flights from one branch to another. Now and again it gave some very soft, rather warbling notes, interspersed fairly frequently with equally quiet grating notes. This 'song' was given so quietly that I could only just hear it 10 yds. away, without being able to distinguish its exact pattern and phraseology.

Blyth's Reed-Warbler (*Acrocephalus dumetorum*)

29 September, 1942. New Delhi. One gave at intervals a low-pitched, but loud *tchuk* . . . *tchuk* from the middle of some thick bushes. Later it gave a subdued warbling song, very like the subsong of an English Robin (*Erithacus rubecula*), with the addition of occasional harsher notes. It was similar in all ways, the quality, composition, timbre, and spacing, and in the delivery—a sort of musing

soliloquy. This continued for several minutes until another bird gave an alarm.

10 October, 1942. New Delhi. One sang for a considerable time from an inside spray of a thick bush. While it was singing it remained stationary, but later it ceased and moved about the bush a little so that I had several good views; then it settled on another perch and sang continuously for a considerable time. The song varied in loudness; for the most part it was fairly quiet, audible for probably 20 yds., but sometimes it swelled into a crescendo lasting some seconds, which could no doubt have been heard at double that distance, and at other times it dwindled to the merest whisper, scarcely audible 3 yds. away. The fact that there was no apparent division between these degrees of loudness, and that the song swelled from a whisper to a respectable volume without any appreciable pause or break, is some evidence of the connection between the ordinary loud song (and through that the primary or territorial song) and subsong. There were slight pauses, of course, but I could not in any instance connect them with the transition from soft to loud or vice versa.

The notes forming the song were extremely varied, sweet, pure notes being included in about equal proportion with comparatively discordant notes. Some of the phrases were warbled, but the majority were given separately in a very similar way to the songs of Sedge-Warblers (*Acrocephalus schoenoboenus*) and Reed-Warblers (*A. scirpaceus*) in Europe. The phrases were strung together very rapidly as a rule, so that the general effect was a warbling, and it was impossible to make a fully accurate record of the notes given.

The following, compiled from notes I managed to make at intervals during the performance, gives a fairly good idea of the general nature of the song, but these notes do not represent any complete phrase and were not all given consecutively.

Chupchup-t—heee—heee—see—wk'wk—se-se-sa-seu—wk'wk—tsitsiweeea—tck-tck—wripwrip—picpicpic—seeea—brk'brk'brk—seeea.

Booted Warbler (*Hippolais caligata*)

20 October, 1942. New Delhi. One was singing in a babool tree growing among thorn bushes. Almost all the time it was singing it was moving about the tree hunting for food in a somewhat half-hearted way, as though its song were its main interest and the food only a secondary one. It moved by short hops, both forwards and often sideways along the twigs, never more than a few inches at a time, pausing now and then to devote itself to its singing for a few seconds before moving on. Now and again it would pause for a second or two in its song to stretch up to a leaf or crevice in the bark, or to hang nearly head downwards.

The song was a quiet, varied warbling, not particularly striking in any way by reason of any special characteristic, but generally pleasing to the ear, and it included only very few discordant notes. It was inclined to be rather hurried—the sequence of notes was in any case much too rapid for me to be able to make an exact record of them. At times it rose into a fairly full, loud warbling, though even at its loudest I doubt if it would have been audible more than about 30 yds. away. Usually it was much quieter and once it sank so low that I could only just hear it 4 yds. away. There was no real pause or other line of demarcation between the loud and the quiet song, and I could detect no difference in quality, timbre or character between them. Many of the notes used were short, almost staccato ones, but they fitted into the song as a whole to produce a warbling result.

Once when I moved round the tree to get a better view of it, the bird ceased singing and gave two different notes of protest. (a) *tjä* (German ä) repeated 8-9 times fairly rapidly; and (b) a very sparrow-like *chrrr*. But it resumed its singing within about two minutes of the interruption.

Maroon Oriole (*Oriolus traillii*)

24 May, 1943. Darjeeling. A pair was among Siris, etc., trees growing among tea bushes on the hillside. On my arrival one bird (presumably the male) was giving the usual *pelulu* calls with many variations which I did not attempt to record. After a few minutes of this, however, when I was standing only some 15 yds. away, this bird suddenly broke out into a rambling warbling, quite different and far more complicated and polished than the usual calls, but often including these, sometimes in a slightly distorted form. Most of this warbling was continuous with few pauses and was given a good deal more quietly than the usual notes, but hardly quietly enough to be classed as a real subsong. It varied a good deal in loudness, however, from a stage whisper audible perhaps 25 yds. away, to a fairly loud song only slightly softer than the usual calls which have considerable carrying power. It usually became louder as it led up to one of the usual notes and softer again immediately afterwards.

While the bird was giving this song it hopped unconcernedly about the tree, pausing now and again to reach up among the large seed pods after food. The singing lasted for perhaps three minutes and then the bird was driven out of the tree by an Ashy Swallow-Shrike (*Artamus fuscus*); after that it was conspicuously silent, only occasionally giving one of the usual loud calls.

Tree Pipit (*Anthus hodgsoni*)

27 March, 1945. Myitkyina, N. Burma. I had several excellent views of birds which I think must have belonged to the Yunnan race (*Anthus h. yunnanensis*), while they walked about on the ground within a yard or two of where I was standing. I heard one bird giving a very quiet song as it wandered about foraging. This song was a sort of whispering soliloquy based on *psiri*, with divers variations and modulations, and the result was quite pleasant. The colouring seemed to me to be rather more intense than the birds I saw in Bengal, with much less green and more brown above, rather more rufous and less pale buff below, and the whitish eyestripe was very marked.

Note: In the above records I have used the words 'quiet', 'soft' and 'low' somewhat loosely as meaning the opposite to loud. Such looseness of speech is obviously undesirable and might lead to confusion in an extensive study of song, but I have not altered it in these records as I wished to deviate as little as possible from the original wording of my notes.

SUMMARY

In addition to the loud, persistent, primary or territorial song, many birds have songs of secondary importance. This may take the form of autumn or winter song; song of hen birds; rehearsing song of young birds; very quiet, inward whispering song similar to the primary song, or subsong differing from the primary song; or rather louder songs given only occasionally. Instances are given of secondary songs of fourteen species of birds occurring in India and Burma. The whole question of secondary song is one which merits much greater attention than has hitherto been given to it and it is likely that a wide study of it might disclose interesting evidence on other aspects of bird life, particularly the evolution of species and sub-species and their specific primary songs.

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A CORRECTION: 'Some Jungle Bird Associations' [*J.B.N.H.S.*, 50 (3)—April, 1952—p. 588] delete asterisk indicating occurrence against Redwinged Bush Lark (*Mirafra erythroptera*) in column III (Darjeeling).—M.D.L.

REVIEWS

1. **INSECTS INDOMITABLE.** By Evelyn Cheesman, F.R.E.S. Pp. 205 (7½″ × 5″). With 16 line illustrations by Arthur Smith. London, 1952. (G. Bell & Sons Ltd.). Price 12*s*. 6*d*. net.

Evelyn Cheesman, in her capacity as the Curator of Insects in the London Zoo, has had the opportunity of observing insect-life for over a quarter of a century. During her studies she sees that insects are able to thrive with ease even under the most exacting circumstances, and learns that the secret of their capacity to do so, lies in their possessing an elastic body structure and a physical constitution which readily respond to and adjust themselves with any environment. Hence the title of the book 'Insects Indomitable', which she more than justifies in the course of its pages.

The book is divided into eleven chapters, each with a title. In these chapters the reader is introduced to those amazing ways of insect-life which appear at once wise and skilful, although insects are devoid of any powers of thinking. The first two chapters are devoted to general structure and organization of a typical insect. The rest of the chapters deal with such phenomena as dispersal and migration, relationship with plants, etc. Speaking of protective devices, Cheesman observes that the art of camouflage has reached its perfection among insects. The chapter 'Social Organization' deals with life in colonies like those of ants, bees and wasps, which according to the authoress are the most highly evolved of insects. It is interesting how, having made a stealthy ingress into a colony, the 'cuckoo' queen eludes capture and finally usurps the queenship by killing the real queen.

The style is simple and elegant, and the print bold and the get-up good. There are scarcely any technical terms in the text to baffle the lay reader. The illustrations, although mere line-drawings, are apt and well-chosen, and are neatly executed. The index at the end is an added facility.

The book is delightful reading both to laymen and entomologists and is a worthy addition to any library.

V.K.C.

2. **WILD FLOWERS OF THE CEYLON HILLS.** Some Familiar Plants of the Up-country Districts. By Thomas E. T. Bond. Illustrated by Jessie & Thomas Bond. Pp. xviii + 240, 22 × 14 cm., col. front., and 120 line drawings. Oxford University Press, 1953. Price Rs. 10.

'This book has been written to attract the general reader for whom no other book on Ceylon's wild flowers exists . . . It describes 120 of the most common species to be found above the 3000-foot contour-line. Thus the favourite wild flowers of Ceylon's most popular holiday resorts are described here.' (From the publisher's note on the dust cover of the book).

After a short introduction setting forth the aims of the author and giving useful references for the interested reader, the book opens with the list of contents, where plants are catalogued by the scientific, English and local names. For the amateur there is then a very simple guide to the identification of the species; the guide is mainly built on the colour of the flowers, other useful characters being the size of the plant, the regular or irregular structure of the flower and the number of its parts, characters all that can be understood by the lay reader without much trouble. Both the guide to the identification and the book itself may be termed 'Botany without tears'.

The plants are listed by families. For each of these there is a short general introduction showing its distribution in the world, and its occurrence either in the wild state or in cultivation in Ceylon. Each species is given under its scientific and local names, with a short note on the colour and size of the flowers. In the description of each plant the author uses non-technical language, and pays attention mainly to those points by which the plants may be easily identified. One interesting point is that the scientific name of the plants are explained, and this makes them less frightening than they usually are. In every case the description is accompanied by a clear line drawing of the plant; the drawing is always opposite the description, and by this means the author will help many readers to keep their tempers, not an easy matter when the reader has to be constantly turning the pages of the book to compare the description with the picture. This is a very happy idea of the author.

Another feature of the book is that the complicated problem of the scientific names is simplified to the utmost; in general the names of Alston's Supplement to Trimen's Handbook of the Flora of Ceylon are used; but to help the reader who may wish to consult Trimen's Handbook, the latter's names are given in brackets when they differ from those adopted in the book.

A few technical terms become essential, and these are fully explained in the Glossary at the end of the book. The Index lists all the plants by their scientific, English and local names.

On the negative side, there are but few remarks to make. Some of the illustrations have been somewhat spoiled by the text of the following page coming through. Another point is that the illustrations do not show any scale to indicate the size of the plant; thus, e.g. illustr. no. 34 is clearly larger than natural size, whilst no. 63 is only 1/10 or even less of natural size; in my opinion this omission of the scale detracts a little of the value of the illustration, as the reader, unless he or she be very careful, may be induced into error.

Both the aim and the presentation of the book deserve praise. The text is neat, the figures simple but showing the main points by which the plant may be identified. The cost of the book is moderate for those who can afford a holiday in the hill resorts of Ceylon. We wish the book every success.

H. SANTAPAU, S.J.

3. BIRDS OF CEYLON, 2. By W. W. A. Phillips, F.L.S., M.B.O.U., F.Z.S. Pp. 49 ($7\frac{1}{4}'' \times 4\frac{3}{4}''$), 1 coloured map, 5 photographs by author, 20 coloured plates by Cicely Lushington, Colombo, 1952. The Associated Newspapers of Ceylon Ltd. Price Rs. 5.

This is No. 2 of the introductory booklets on Ceylon birds, the first of which was reviewed on p. 534 of Vol. 49 (3), 1950. It describes and illustrates 24 species selected as the most representative birds to be met with about tanks and swamps. The selection, as the author admits, cannot have been easy considering the large variety of species which affect such habitats, but it is on the whole well made and includes most of the commoner birds usually met with on practically every tank, large or small, in Ceylon as well as India. Ceylon has the distinction of possessing some superb bird sanctuaries at and around several of its tanks. These mixed heronries present a remarkable spectacle during the season when the birds are nesting, and are a source of unfailing pleasure and inspiration to the bird watcher and photographer. This handy little volume with its terse descriptions and commendable plates should be of very special usefulness to a visitor to one of these show places, whether a beginner or a seasoned ornithologist.

The intending bird photographer and the more advanced worker alike will specially welcome the chapter on Bird Photography in Ceylon. Mr. Phillips's proficiency as a bird photographer is widely known and justly recognised; and his suggestions for the building of various types of hides, and his views and experience on cameras and equipment are illuminating.

Two more booklets are still to come to complete this admirable series. All together, they will comprise a handy reference work and a useful contribution to the popular bird literature of Ceylon.

S.A.

4. AFRICAN HANDBOOK OF BIRDS, Series One: Birds of Eastern and Northeastern Africa, Vol. I. By C. W. Mackworth-Praed, M.A., F.Z.S., M.B.O.U. and Capt. C. H. B. Grant, F.Z.S., M.B.O.U. Pp. xxv + 836 (8½″ × 5½″). 53 coloured, and 6 plates from photographs; marginal distribution maps and drawings. London, 1952. Longmans, Green & Co. Ltd., Price 45*s*. net.

No one seriously interested in the study of Indian birds can afford to follow a policy of isolationism. To obtain his proper bearings he must have at least a general 'awareness' of how the pattern of Indian avifauna compares with that of neighbouring countries, and of its strength or weakness in the various families and species. Nor is it enough that he has a bare list of names for comparison. He must have a workable picture of the biotopes and physiographical conditions under which birds live in neighbouring lands so as to be able to make pertinent comparisons and reflect upon all divergencies in the habits and behaviour of species common to the two countries, or closely similar and obviously representing one another.

There is much in common between Africa and India both as regards climate and physiography. Apart from the Palaearctic elements in our avifauna common to both the continents either as residents or migrants, there are certain sections of resident Indian birds which have been clearly derived from Africa, and vice versa, at a period when north Africa and western Asia were connected by a forest belt which extended across north Arabia and Iran to northern India, a region that is now arid semi-desert or even completely barren. Apart from the presence or absence of various permanent elements, there is a certain amount of seasonal traffic either between India and Africa directly or emanating from the same 'reservoir', which makes at least a nodding acquaintance with African ornithology essential for the student of Indian birds. The book under review supplies this need admirably. The present series deals with eastern and northeastern Africa which comprises 'the Anglo-Egyptian Sudan, Eritrea, Abyssinia, the Somalilands, Socotra and Abd-el-Kuri Islands, Kenya Colony, Uganda, Ruanda, Urundi, Tanganyika Territory, Pemba, Zanzibar and Mafia Islands, that part of northern Portuguese East Africa east of Lake Nyasa and north of the Zambesi River, and that part of Nyasaland east of the Shire River.' Vol. I contains all the non-passerine families from Grebes to Swifts, plus the Broadbills and Pittas. Vol. II will complete the rest of the passerine families and conclude Series One. We understand that Series Two dealing similarly with the birds of southern and south-western Africa is in course of preparation by the same authors.

In their preface the authors mention that the book is intended mainly for use in the field, and all the features—one might say of omission and commission—are pivoted on the effort towards this end. Therefore, many of the apparent shortcomings spring from the necessary compromises.

The volume covers 653 species, some 400 of which are illustrated in colour on 53 plates mostly the work of Roland Green and the late H. Gronvold. In spite of drastic compression—in some cases perhaps a bit too drastic—it was inevitable that a tome of this compass should be a bulky one. It is two inches thick and weighs over 3 lb! Keys are given for families, which may comprise a variable number of genera. The Ardeidae for example, contains 15 genera including herons, egrets and bitterns. This arrangement simplifies reference for the amateur who may recognise these birds as closely related but may not know the separate genera into which they are split. The key to the Anatidae, including both ducks and geese, is also convenient from this point of view since it gives an overall picture of this group of obviously allied birds and not of its various components cut off from one another. But this system of keys is less convenient and fruitful to use in the case of prolific families, e.g. the Birds of Prey, the three families of which together (i.e. Ægypiidae, Falconidae and Pandionidae) contain no less than 83 species. Also one is sometimes apt to be left in the air even after laboriously following the clues to the end. For instance as between the Tawny Eagle and the Steppe Eagle (p. 122) the crucial point of distinction one arrives at is that in general colour the former is 'tawny, brown or rufous brown' while the Steppe is 'dark brown'. In many instances, of course, the difference in the browns is largely what one chooses to call it; neither do the illustrations of the two species on Plate 11 help. The wing measurements partly overlap so that in cases where this happens it is almost impossible to make up one's mind even with a specimen in the hand, leave alone one in the air! However, apart from inescapable exceptions of this sort the keys are on the whole workable though their efficacy in *field* identification, and without a specimen in the hand, may in many cases be questionable.

Of the Lesser Flamingo (*Phoeniconaias minor*) it is stated (p. 83) '. . . breeds in the Persian Gulf, in India and sometimes in Ceylon'.

Long ago Hume and others recorded stray dropped eggs, allegedly of this species, from the Sambhur Lake neighbourhood (Rajasthan), but actual breeding is so far unconfirmed. In Ceylon, as far as I am aware, all allegations of breeding have referred only to the larger species (*Phoenicopterus ruber*) and these have never been substantiated. That the small species *may* breed in the Little Rann of Kutch is of course a probability, judging from the numbers of very young birds in the brown plumage frequently seen there.

On p. 506 *Clamator jacobinus pica,* our larger north Indian form of the Pied Crested Cuckoo with white underparts, is treated as merely a colour phase of *C. j. serratus* the African bird with black underparts. Other authorities (e.g., Friedmann) consider them as different races. Certain it is that the white breasted form (believed to be a rains visitor from Africa) is the only one found in N. India and never *serratus* with black underparts.

Among the major drawbacks, in the reviewer's opinion, which may partly be from the effort to compress, the following may be enumerated:

1. Absence of a good physical map of Africa, preferably coloured and showing vegetational zones,
2. Absence of a list of plates at the beginning which now necessitates referring to the text, or to the irregularly scattered plates, to discover what species are illustrated and what not. This difficulty could have been partly met by using in the index bold type for the species illustrated in colour, and italics for those in the photographs.

Since the printing, the paper and the general get-up of the book are so excellent, it seems deplorable indeed that the reproduction of the coloured plates—so vital an aid to field identification—leaves so much to be desired. It is understandable that size had to sacrificed in order to include the maximum number of species, but in that case it would have added enormously to clarity had the elaborate backgrounds been left out altogether. It would thus have been possible also to illustrate a greater number of species on each plate while at the same time permitting of larger portraits. In any case there seems no excuse for the colour impressions in so many of the plates to be out of register. Surely this could have been avoided by greater care in printing.

One more point which has curiously been overlooked is the indication of a scale in inches or centimeters under each illustration. Without it it is not easy for those unfamiliar with African birds to get a correct idea of the size without some unnecessary research.

In spite of these minor blemishes this is undoubtedly a first class contribution to ornithological literature, and the authors deserve to feel gratified and to be congratulated upon the culmination (in part) of their prolonged and painstaking labours. Ornithologists in India will welcome its appearance as warmly as those more directly concerned with African ornithology.

S.A.

5. NESTBOXES. By Edwin Cohen and Bruce Campbell. Field Guide No. 3, published by the British Trust for Ornithology, Oxford. Pp. 32 (8½″ × 5½″). 22 text figures, 1952. Price 2*s*. 6*d*.

One of the most fruitful ways of attracting birds to gardens and vacant plots in urban areas, or to forest plantations, whether for aesthetic or economic purposes, is by the provision of food and suitable nesting sites. In well wooded areas the former is usually plentiful enough for insect-eating birds, but nesting sites are scarce due to the artificial management of stands—the removal of decaying branches and clearing away of overmature timber which normally cater for the hole-nesting species.

Where a sufficiency of food is vouchsafed, it has been found possible to induct a much larger number of birds per acre by the provision of boxes and other nesting facilities than is the case under natural conditions. On p. 891 of Vol. 35 of the *Journal* Mr. B. B. Osmaston records that out of 12 nestboxes put up by him in one small area of forest in the Andamans, no less than 9 were occupied by Shamas (*Kittacincla macroura*).

This useful little pamphlet will be welcomed by all bird lovers. It gives diagrams with exact measurements and instructions for making several different types of boxes that have been tried with success on various British birds. The second section deals with just those things that a prospective 'boxer' wishes to know: Materials, Siting, Density, Fixing, Inspecting boxes, Protection of entrance holes, Nest-material, Keeping records, Artificial sites, Bibliography and Supply of nest boxes.

There are great possibilities in India from this method of attracting birds both as regards the enjoyment to be obtained and the opportunities it can provide for detailed scientific study of the life-histories of numerous species, some of them perhaps amongst the commonest, but about which our knowledge is nevertheless almost nil.

Copies of the pamphlet may be had from the Secretary, British Trust for Ornithology, 2 King Edward Street, Oxford, on remittance of the price plus 1½d for postage. The two other equally useful Field Guides previously published by the Trust are: No. 1. Trapping Methods for Bird Ringers (reviewed in Vol. 49 (4) p. 773), and No. 2. How to choose and use Field-glasses.

S.A.

6. MAN, MIND OR MATTER. By Charles Mayer. Translated from the French and with a preface by Harold A. Larrabee, pp. 167. Boston, 1951 (The Beacon Press).

The author states in his preface 'This book is an attempt to set forth a renovated and rejuvenated philosophy of Rationalistic Materialism'. Further down in the preface he indicates the plan of the book: 'The work is divided into three parts. The first deals with our knowledge of the physical world, and the second more specifically with the world of living things. In the third part, after indicating what conclusions follow from a denial of the supernatural and of any ultimate purpose in the world, we shall show that in place of the traditional systems of morals, it is possible to substitute an ethics derived from the idea of progress and capable of satisfying the highest aspiration of man.'

From the foregoing the reader expects the small volume to be packed with dispassionate systematic reasoning. The succeeding chapters, 19 in all with a conclusion and an appendix at the end, do not come upto that expectation. The continuity of thought from chapter to chapter, and even within individual chapters is not always apparent. Heavily controversial questions are introduced but not treated with the attention, the thoroughness and the intellectual sincerity they deserve. The conclusions, if any, arrived at are often arbitrary and unsupported either by data or sound reasoning. For example the question of 'Free Will: Reality or Illusion' is disposed off in a chapter of just over two pages with the remarks that the problem 'is after all just a jeu d' esprit' . . . . . . an imaginary problem. It exists only in our minds'.

At the outset the author formulates his position that matter has existed from all eternity and contains within itself the seed and principle of its own continuous evolution. All explanations that are not founded on sense experience are to be rejected, therefore there is neither justification, nor actually any necessity for postulating a non-physical entity or an intelligent directing principle to explain the nature of the Universe; and the development of simple physical matter into living forms of a more and more complex structure which have culminated in man and his mind. All is essentially matter and no new outside principle is needed to explain the metamorphoses.

The author speculates that certain organic molecules must have by chance so modified their structures as to develop the curious faculty of 'irritability' or sensitivity and capacity to react to environment. The author uses the term 'irritability' throughout the book to describe the faculty.

This irritability though it is a characteristic of living matter is emphasised as being a phenomenon of the physical order, akin to magnetism. It manifests itself more explicitly in all individual living beings, from the simplest cell upwards, as a will to live, and as a tendency to pursue the pleasurable and avoid the painful. This dual principle working in the individual living creature is both the driving force and the mechanism of biological evolution.

The author entertains some startling beliefs in support of his theory. For instance that the development of nectaries in flowers is due to the fact that the exudation of nectar 'undoubtedly relieves it (the plant) or even yields it a sexual satisfaction . . . . . Little by little there has come about a specialisation of these exudations of nectar. Why? Because in localizing itself the felt satisfaction in doing so became more intense' (p. 32). We are further taught about the evolution of colour mimicry in animals, and about the reddish-brown frog which adapts its colour to the conditions of light in which it finds itself. The author believes that the frog has evolved the characteristic by a long process of mechanical adaptation becoming an acquired character under the determining action of the pleasure-pain drive, because 'the reddish brown frog seeks to achieve its maximum well-being by adapting the colour of its skin to the sort of light it encounters, and to that end in conditions of darkness gives its skin a darkish colour in order to absorb a large part of the thermal rays, or on the contrary, takes on a light colour in order to reflect the rays which would otherwise bring it too much heat' (p. 39). It seems needless to extricate and comment on the errors and absurdities involved in the foregoing quotations.

From Chapter X onwards the author explains his psychological and ethical systems. During the exposition a number of topics are touched upon cursorily: Mind, Memory and Consciousness (Chapter x) 'Critique of the Ideal of Moral Obligation' (Chapter XIII), 'Ethical Sanctions' (Chapter XIV), 'Right Laws and Justice' (Chapter XV) and many others appear in the later half of the book.

It is obvious that the author finds it difficult to build up a logically palatable ethics upon a materialistic foundation, and the lack of integration between his ethical and metaphysical opinions is painfully evident.

This latter half of the work is not reviewed at length as the subjects discussed do not appear to be of particular interest to readers of a natural history journal.

D.J.P.

7. DOWNS AND DUNES, their plant life and its environment. By Sir Edward Salisbury. Pp. xiii & 328; (25 × 16 cms.); illustrated with 74 photographs, 93 line drawings and diagrams, together with 54 distribution maps. London, 1952. (G. Bell & Sons, Ltd.) Price 45s.

I have read many of the publications of Sir Edward Salisbury with interest and pleasure; but the present volume seems to surpass most of his previous books. The preparation of the book has taken Sir Edward years of careful work in the field, and long patient hours in the library; originally the work was presented in two courses of lectures by Sir Edward as Fullerton Professor of the Royal Institution of Great Britain. To say that the book is of great interest, particularly for the student of plant ecology, may sound almost like a platitude; I have gone through the book carefully and found it one of the most interesting and attractive books on ecology that I have read for years. To give the reader some idea of the book, I shall try and go through some of the chapters in more than ordinary detail.

The first 12 chapters deal with the downland flora, the rest up to chapter 27 with the dune vegetation; the book is very naturally divided into two parts, and the treatment is more or less similar for both parts.

The Vegetation of the Downs. The author discusses first the geographical distribution of downs in Britain, the physical and chemical characteristics of their soils and the effect of such soils on root development. There follows a bird's-eye-view of the flora of chalky downs; it is interesting to note that about 35% of the chalk flora is made up of rosette plants, all rather similar in habit, but belonging to many different families. In the same chapter the author discusses with the aid of very clear maps the geographical elements of the chalk flora; this chapter closes with a detailed discussion on the root systems of chalk plants. Naturally animals form an important part of the biotic element of the chalk; the notes here given are not intended to be accounts of animal life as such, but only to serve as an indication of the specialised character of this aspect of the environment.

Chapter 4 gives a pattern for the study of chalk plants; over 60 plants are studied in detail; English and scientific names, family name and chromosome numbers are given for each plant; after a short description of the plant in question, the flowering times are noted, together with the geographical origin and distribution of the same. The latter data together with the chromosome numbers are interesting features and should be included in any of our Indian floras, whenever possible. The author then passes to study beechwoods, the characteristic woodlands of chalky hills; often such woods are almost completely devoid of a shrub layer, and this 'enhances the cathedral-like effect produced by the aisles of the smooth columnar trunks'. 'One of the outstanding features of the structure of the seminatural beechwoods is the discontinuity in the ages of the trees and saplings. It is soon realised that these comprise groups belonging to definite age classes, often separated by a period approximating to seven or fourteen years.'

In a further chapter Sir Edward studies colonisation and succession of scrub and cornfield on the chalk, and gives short notes on the help birds and other animals render in these processes; the weeds of the chalk are also studied in detail. Chapter 10 is of particular interest to gardeners, it deals with gardening on calcareous soils; due to the specialised chemical and physical condition of chalky soil the number of garden plants that can be cultivated with success upon it is rather limited; the author mentions a number of trees and shrubs and garden herbs that can be profitably cultivated on such soils.

The Vegetation of the Dunes. The second part beginning with chapter 13 studies the flora of the dunes. The soil consists mainly of sand grains with a limited admixture of organic materials; among the latter shells of various molluscs, etc. give the soil of the dunes its calcium carbonate, dead bodies of both marine and land animals yield a fair amount of nitrogenous material. One of the most typical characteristics of the dunes is their mobility, a very significant feature that considerably affects vegetation, particularly as mobility is usually coupled with a very poor capacity for retaining water. On account of these hard conditions 'sand dunes are to be regarded as temperate deserts the arid condition of which is conditioned not by climatic circumstances as obtain in true deserts but by the lack of capacity of the dune soil to retain water. The sand dune is therefore what is technically known as an edaphic desert.' (p. 165). As a result of the low water content of dunes, plants growing there typically develop long roots, by means of which they are able to reach the water table down below. During summer in sunny days, dunes can attain a temperature of 60°C. or over, and this together with the poor water content of the soil renders dunes very difficult for plant life. On chapter 17 and following chapters the author studies the development of the sand dune from birth to maturity and lists the various plants that help in the process of dune building. Chapter 24 discusses a number of plants that can be seen on dunes and which are normally associated with chalky soils, and the list is rather striking; this chapter explains the reason why the author has united Dunes and Downs in his study.

Chapter 25 deals with the flora of the dunes and its geographical relatives, an interesting chapter illustrated with very clear maps showing the origin and spread of the various geographical elements of the dunes. Plants from the Mediterranean, the South Atlantic, from continental Europe, etc. have come together with a number of native plants to form the typical flora of the dunes of Britain.

The book closes with a select bibliography for further reading on this interesting subject, and with a complete index.

The printing is excellent, it is an honour to the printing trade of Britain; as for the illustrations, photographs and line drawings, it is enough to say that they are masterly and very well selected to illustrate the various chapters of the book. In view of the presentation of the book and the many illustrations, the price of 45*s.* is far from excessive. In spite of the specialised nature of the book, dealing as it does with a restricted aspect of the vegetation of Britain, it is a volume that will be read with profit by Indian students and research workers especially those engaged in the study of plant ecology; the layman, too, will find the book interesting.

ST. XAVIER'S COLLEGE,
BOMBAY,
July 1st, 1953.

H. SANTAPAU, S.J.

8. RECORDS OF PARROTS BRED IN CAPTIVITY. By Arthur A. Prestwich. Pp. 376 ($8\frac{1}{4}'' \times 5\frac{1}{2}''$). London (1950-1952): Arthur A. Prestwich. Price 35*s.*

This is a useful compilation of records, extending over 30 years, of parrots and parakeets from many countries that have bred in captivity, and should be of particular interest to aviculturists and zoological gardens. The index covers some 200 species and subspecies, of which 15 are from the Indian Region. A great many hybrids are recorded. As a work of reference, the publication is to be welcomed.

S.A.

9. SEARCH FOR THE SPINY BABBLER Bird Hunting in Nepal. By Dillon Ripley. Pp. 1-301 ($7\frac{3}{4}'' \times 5''$). London, 1953 (Victor Gollancz Ltd.). Price 14*s.* net.

The recent conquest of Everest through Nepal has re-aroused interest in that relatively unknown land and all literature thereon is sought with interest. What little knowledge we possess about its birds and animals is due largely to Brian Hodgson, who represented the East India Company at the court of the Maharaja about a hundred years ago. As Hodgson's personal activities were restricted to the Kathmandu valley, the majority of his specimens were procured by Nepalese collectors resulting in many of them being indifferently preserved and prepared and often lacking data regarding locality, altitude and other particulars necessary for scientific material. Ornithological work in the Himalayas to the east and west of Nepal focussed particular attention on this unknown area since in many cases different races of birds were found on either side. It was intriguing to guess what natural conditions prevailed in Nepal, and how and where the dividing line between the two races existed.

Dillon Ripley, who has done a considerable amount of work on eastern birds, was fortunate in being one of the first to be permitted into 'unknown' Nepal. The collection of birds and mammals made by his expedition, sponsored jointly by the Yale University, the Smithsonian Institution, Washington, and the National Geographic Society of America, is of great interest.

One of the primary objects of the expedition was to look for the Mountain Quail which was originally discovered around Mussoorie over 70 years ago and which has since completely vanished. The Spiny Babbler which forms the title of the book was really a consolation prize.

The book is a general account of the work and vicissitudes of the expedition written in narrative form for the non-technical reader. It furnishes a good picture of the general routine and pattern which, with local variations, are common to all zoological field expeditions in India, with their accompanying joys and sorrows—the delays, frustrations, and disappointments and the sudden and often unexpected turns of good fortune. Emphasis is laid throughout on the disquieting problem of nature conservation and deforestation. It seems that among the intensely cultivated mountains of the Nepal hinterland the destruction of forest is proceeding at an alarming tempo, the steepness of the hillsides contributing to the speed of the natural denudation caused by the heavy monsoon rains and swollen mountain torrents. It is having disastrous results on the vegetation and animal life as well. The problem of how to grow enough food for our ever-increasing population without seriously impairing forest growth or our natural resources is not peculiar to Nepal; and it is obviously one whose tackling deserves the highest priority if Man is to survive.

Dr. Ripley writes interestingly and even amusingly, and often with a keen insight of men and affairs.

Though the book contains several errors in the transcription of popular and scientific names, all in all it is a readable record of a valuable scientific contribution in the making.

The reviewer cannot however help noticing the episode of the shooting of two chital does as also of a small stag. We should have thought that visitors to our country would respect the rules and usages of such sport as is afforded to them.

The expedition carried special personnel and equipment for photography. It is therefore all the more regrettable that no pictures are included in the book. Readers will agree that good photographs of far away places, interesting peoples and customs are important factors in the make-up of modern nature-cum-travel books.

H.A.

10. WILD ELEPHANT CHASE. By Heinrich Oberjohann. (Dobson, 15s.)

A reviewer should have no feelings, only judgment, and his judgment should recognise no values other than literary. Until a machine is invented which can shoot out a criticism of a book, he should try to be that machine. Sometimes, however, his feelings intervene, and where no literary element is present to distract him they may even boil over.

Herr Oberjohann is, or was, since no biographical details are provided after 1938, a German explorer, intrepid, resourceful, who because of his 'passion for animals', obtained employment with various dealers, notably Hagenbeck, and went out to stock his zoos and circuses. 'Not content with capturing animals, Oberjohann was

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always intent on studying their behaviour and psychology, on understanding them and making himself understood by them.' 'Wild Elephant Chase' describes the cream of four years of hardship and adventure in the Lake Chad region, where, he was told, the largest elephants in Africa were to be found, tormented by insects but secure, in their impregnable swamps, from man.

When Herr Oberjohann arrived, like Tribulat-Bonhomet the swan-killer, in his home-made leather suit, with his guns and beaters and whip and pipe, the herd numbered about two hundred. For the next four years, the animals were to know no peace while Herr Oberjohann dogged their footsteps, examined their droppings and abducted nineteen small calves, all of whom died, their griefstricken mothers going mad or being shot together with any adult animals who allowed him to approach them. In addition he conducted some experiments to prove that baby elephants who were impregnated with his scent were trampled to death by their mothers. We can therefore estimate that he reduced the herd by about fifty during the four years in which he 'understood' them.

Occasionally he permits a crocodile tear to water his home-made buckskin:

'I looked over at the dying cow: she was bleeding profusely and a big patch of the water in front of her was coloured a deep blood-red . . . Now the sounds from the cow grew. She was talking in her own tongue, the elephant language. I wished I could understand what she was saying. It was an uncanny sound and it got under my skin, for it was through my own brutality, my crime against nature, that this elephant mother lay dying. I longed to escape. I refused to remain any longer as witness to this tragic scene. I wondered whether the people back home, whether Carlo Hagenbeck himself, had any idea of the unspeakable tragedy which is involved in robbing a fellow creature of its freedom.'

In the next chapter he has quite recovered:

'I fired: the leading elephant went down on his knees. One of the cows, refusing to be frightened off by the death of her companion, rushed wildly ahead.

I fired again. The cow collapsed. Now I turned my attention to the baby elephants.'

Mindful of the casualties of Hiroshima, we proudly call this the Atomic Age, but future historians may look back on this century as the time when man finally exterminated everything larger than himself and ceased to be a trustee for the older forms of life on his planet: Whales, basking-sharks, dugongs and manatees, sea-lions, sea-leopards, and sea-elephants, walruses and polar-bears, giraffes—and elephants. Capable of living to a hundred, of kissing, of combining together, of thinking ahead, and endowed with extrasensory perception or telepathy, their continued existence is clearly intolerable.

Perhaps the French authorities of the Chad region could take them under their control, perhaps the four Powers who control tropical Africa could pool the remaining herds in a safety zone, as in the Belgian Congo. Meanwhile we can do little but hamper Herr Oberjohann's further exercises in 'understanding' by omitting to read a book in which so much fascinating elephant lore is purchased at such fearful cost by a man who, knowing he is doing wrong, is yet unwilling to stop.

CYRIL CONNOLLY

[This review is reprinted from the *Sunday Times*, London, May 17, 1953, by kind permission of its editor. It is to be hoped that Herr Hagenbeck on whose behalf all these brutalities were ostensibly committed will be as nauseated by the unashamed disclosures of his unspeakable minion as every humane person and wild life conservationist is bound to feel, and that he will take suitable steps to end this disgusting business. It is also hoped that the book will be an eyeopener to the governments in whose territories Mr. Oberjohann and his tribe pursue their despicable trade, and will help to set in motion the urgent and drastic measures called for.—Eds.]

The following books have been added to the Society's library since May 1953:—

1. The Preservation of Wild Life in India.—A compilation with a summarized index of contents. By Lt.-Col. R. W. Burton (Bangalore Press, 1953). (A presentation copy).
2. Life of the Shore and Shallow Sea. By Douglas P. Wilson (Ivor Nicholson & Watson, 1935). (A Review copy).
3. Records of Parrots Bred in Captivity. By Arthur A. Prestwich (Arthur A. Prestwich, 1950-1952). (A Review copy).
4. Wild Flowers of the Ceylon Hills. By Thomas E. T. Bond (Oxford University Press, 1953). (A Review copy).
5. Man: Mind or Matter. By Charles Mayer (Beacon Press, 1951). (A Review copy).
6. A Pocket-Book of Lesser-Known British Birds. By Wilfred Willett and Charles A. Hall (Adam and Charles Black, 1952).
7. Nestboxes. By Edwin Cohen and Bruce Campbell (British Trust for Ornithology, 1952). (A Review copy).

MISCELLANEOUS NOTES

1. A LOCAL VARIETY OF THE NILGIRI LANGOOR

In June 1952, Mr. Angus F. Hutton sent us three skins of the Nilgiri Langoor (*Kasi johnii*), 2 adult and 1 juvenile, obtained at Rousdon Mullai, south-west slope Nilgiri-Wynaad, and drew attention to the fact that they all had greyishwhite buttocks and thighs, which he said gave them the appearance of 'wearing white bathing trunks' in life.

The description in the Fauna of British India—Mammals (Pocock) p. 148 reads:—

> 'Frequently there is a conspicuous grizzled patch on the loins whence it spreads on to the extreme root of the tail, and on the upper part of the thighs; this patch varies greatly in distinctness, and may be undetectable.'

Mr. Hutton, who appeared to be familiar with ordinary Nilgiri Langoor, wrote that this variety was confined to an isolated valley of the south-west Wynaad Plateau at an elevation of 1,500 ft. He estimated their number at not less than 50.

As it was not possible to match these three skins in the Bombay collection, they were sent to the British Museum. Mr. R. W. Hayman's report on them reads, in part:—

> 'It would be interesting to ascertain if this variety is restricted to one place, or if individuals turn up throughout a known range of this species.
>
> On comparison with our specimens, I find that although Hutton's two adults have a more clearly defined grey rump than the majority of ours, it is not quite so obvious as in the photographs. And we have an adult skin, unfortunately with no locality, which is fully as grey on the rump as your skin.
>
> Although it may be the case that in one particular area this extra greyness is characteristic, such a character may well be a 'family' feature. For instance, in one locality on the northern slopes of Mt. Kenya the local black and white *Colobus* monkeys have a strong tendency to albinism, and most of their normal black pattern has disappeared. But it is not considered necessary to distinguish them by a scientific name, and I think the same would apply to the skins under discussion, especially in view of the unknown locality of a B. M. skin exactly like yours.'

114 Apollo Street,
Bombay-1,
May 15, 1953.

EDITORS

2. THE SOUTH INDIAN PANTHER—*PANTHERA PARDUS FUSCA*

The Indian panther found on the Mysore plateau is a short haired animal with a fulvous coat, white belly, and black rings in the form of rosettes all over the body, and rings on the tail. There is considerable variation in the colour, the animals found in the denser and shadier forests of the Western Ghats having a richer colour than those inhabiting the drier, open country. Black panthers are not uncommon, but they are relatively more abundant in the evergreen or sub-evergreen forests of the Western Ghats than in more open country. Strangely enough, the first panther I shot during my professional forest career (Christmas, 1928) turned out to be a black panther, and this was in the evergreen forests of the Western Ghats at a place called Agumbe in Mysore State. A black panther's spots are distinguishable only in bright light.

The panther is in habit very watchful and stealthy. It has a great faculty for concealment, utilizes even the most meagre cover for this purpose and often infests villages and solitary homesteads, carrying off sheep, goats, poultry and dogs, the last being its favourite food near human habitations. In forest areas it sometimes feeds on monkeys, and it is this habit which makes it an ardent tree climber.

Though apparently similar in its ways to a tiger, the panther has several distinctive characteristics. It is more ubiquitous than the tiger and less affected by the advance of cultivation; but the most striking difference between these two felines lies in the ease with which the panther can climb trees. This advantage renders it far more cunning and careful than its striped relative. The 'kill' of the panther can be distinguished from that of a tiger by the fact that the panther generally attacks first the shoulder muscles and the chest, whereas the tiger starts tearing out the more massive muscles of the thigh in the region of the buttocks. A big panther may, however, start its feed at the hind quarters much like a tiger.

The tiger likes water and spends the hot summer afternoons sometimes wallowing in it like a buffalo, although it always selects a clear forest stream and does not take to muddy or stagnant pools. The panther avoids water and does not readily swim, though when compelled it can do so as well as the tiger. Being less fond of water than the tiger, the panther is frequently found in very dry zones. It is also more tolerant of the sun, and makes its abode on the parched, treeless, rocky hills of the Deccan, where there is often nothing better than low, thorny scrub. Here it lives amidst the numerous rocky clefts and crevices.

The panther is also infinitely more audacious than a tiger and regularly haunts the vicinity of villages where it sometimes becomes a scourge to human life and property. Such panthers have been called 'Village Panthers' (*J.B.N.H.S.*, 1933, p. 105), to distinguish them from those which live in forests known as 'Forest Panthers'. Domesticated animals can be more easily taken by the panther than wild ones, but in doing so it comes into conflict with man and thus develops greater cunning, boldness and resource than the tiger.

Like the tiger, the panther sometimes takes to man-eating, and a man-eating panther is even more to be dreaded than a tiger with similar tastes, on account of its greater agility, and also its greater stealthiness and silence. It can stalk and jump, and, as already stated, can climb better than a tiger, and it can also conceal itself in astonishingly meagre cover, often displaying uncanny intelligence in this act. A man-eating panther frequently breaks through the frail walls of village huts and carries away children and even adults as they lie asleep. The writer has come upon forest labour camps in which young children sleeping between their parents, or babies coddling in the arms of their mothers, have been seized at dead of night, the brutes concerned having forced their entry into the human tenements by breaking through their improvised doors. So stealthy and cunning is a man-eater, and often so accomplished in its tree climbing habit, that shikaris perched on *machans* on trees have been carried off by the very animals for which they lay in wait (Lydekker 1924).

On one occasion, in May 1936, I nearly lost my life while waiting on a *machan* over a panther kill in Kukwada—Unbrani state forest (Bhadravati division). A live bait had been tied up for a tiger which was taken during the night, the hind-quarters having been attacked by the feline. Assuming the killer to be a tiger, I sat up on a *machan* in a large spreading banyan tree (*Ficus bengalensis*) about 120 yards from the kill. The animal did not come to the kill on the first night. Between 12 midnight and 3 a.m. a long string of bullock carts carrying timber passed that way and, as usual in tiger-infested areas, the cartmen made a lot of noise, which appears to have scared the animal away. This was ascertained next morning by examining the pug marks of the animal which were visible up to within a hundred yards of the kill, but had then gone back along the same path. At the point from which the animal had retraced its steps, it seems to have sat and watched for some time, and, also, it had rolled about in the dry loose and cool dust, just as a tired horse does, a habit which seems to be somewhat strange and uncommon in the case of a feline. Why the animal did not come to the kill, whether it suspected something wrong or whether it had been scared away by the noise of the timber cartmen one cannot say. The next evening I again got on the *machan* with gathering dusk—about 7 p.m., prepared, as previously, to sit out the whole night. The animal came to the kill within half an hour and started its meal in right earnest. The torch was flashed in its direction, but the brute was not visible because it was crouching low on the off-side of the kill where the light cast a long shadow. Unmoved by the flood of light, however, it continued its meal. So, raising my voice I repeated three times 'la-la' upon which the animal quickly withdrew into the bushes, but it returned to the kill in a few minutes and resumed crunching the bones. The torch was flashed on a second time, but only the hind portion of the animal was visible the rest being effectively screened by the kill; it was a panther. A carefuly placed 12-bore bullet in the region of the lungs and with a terrific roar the brute disappeared, but its panting growl continued to be audible from the bushes about 150 yards away on the right hand side of the kill. Obviously its lungs had been punctured and it was having difficulty in breathing. There was no time for a second shot, nor was it advisable to flash the torch again at the wounded animal. An hour and a half later, at about 11 p.m. all noise from the animal had ceased. Dead silence prevailed till about 2 a.m., when, suddenly I heard some scratching noise on the bark of my tree. It was now pitch dark, the little moonlight which had existed having gone. At first the noise was mistaken for that of a field mouse scrambling up the bark but a moment later, the branches of the tree shook as if rocked by a heavy object. The torch was flashed in that direction and, to my surprise and horror, I found the panther, eyeing me dangerously from a neighbouring branch hardly 14 ft. away. Fortunately the 12-bore, loaded with buck shot and bullet in its two barrels, lay ready to fire, and both the barrels were emptied one after another into the animal. The brute fell off the branch—dead—but it was not before daybreak that I could leave the *machan*. Neither the animal's approach to the tree, nor its scrambling up could be heard beyond what has been described above, and had I been dozing on the *machan*, as sometimes happens during the early morning hours, this tale would perhaps have remained untold.

Its almost absolutely noiseless approach, astounding capacity for concealment and its lightning agility in attack make the panther one of the most formidable animals to encounter. On another occasion I lost one of my favourite dogs (Pfuffy) from underneath my writing table even as I sat working on the verandah of the P.W.D. resthouse at Kadur (Mysore State), a dry area in that part of the country. It happened at the end of a hot afternoon in April when the first pre-monsoon showers had cooled the evening air. The dog was sitting at my feet in the darkness of the shadow cast by the kerosene lamp on the table. The panther was first noticed by me, as I sat absorbed in my office files, only when it was in the act of leaping off the raised verandah pavement with the dog in its mouth, and that too because the dog sounded its first and last note of agony, before its voice was finally stilled in death. There was no bush close-by in which the brute could have been taking cover. An examination of its pug marks left on the wet mud, showed that it had approached the edge of the verandah under cover of darkness right across the open space which separated the masonry pavement from the green beyond. There it lay watching, flat on the earth, just beyond the edge of the pavement, may be for the space of a few minutes. Then, perhaps tired of the waiting, it grew bolder and making use of the long shadow, cast by the kerosene lamp on the table, to cover its uncannily silent approach, it rushed at the dog which lay dozing at my feet oblivious of the lurking danger, seized it by the throat and made off, all in an instant, towards the low scrubby forest growth at the edge of the compound and disappeared for ever. A beat organised in the nearby patch of scrub forest next morning proved unsuccessful.

Like the tiger, the 'forest panther' follows the beaten tracks of animals or lies in hiding for its prey. It attacks its prey from the ground, either seizing its neck from below and biting through the trachea and the main arteries after wringing the neck, or springs down upon it from an overhanging tree. A well grown panther may also spring upon the shoulders of the quarry from a side and bear it down by its own weight, breaking the neck of its victim during this onslaught. Though preying practically on the same kind of animals as the tiger—the deer tribe and pig in forests, and cattle, sheep and goats near human habitations—the panther, in keeping with its smaller size, attacks animals of the smaller variety leaving the full sized ones generally to the tiger. The panther also takes to eating small animals like the porcupine, hares and even the smaller rodents, and village panthers often lift poultry. A panther returning to its kill is often extremely cautious, but in this respect the animal which inhabits forest regions is different from the village panther, which has come in contact with human beings. The former approaches the kill boldly, and does so even after being once shot at, provided, of course, that it is unhurt. So, too, does a forest tiger inexperienced in the ways of man. A panther which dwells in the vicinity of human habitations, on the other hand, is the 'personification of cautiousness'. He approaches the kill slowly and deliberately, watching the surroundings of the kill every instant and frequently surveying carefully the trees around it. Anything causing the least suspicion will make it give off a 'whoof' of surprise and abandon its meal rather than take the smallest risk.

A pack of wild dogs is more than a match for a solitary panther, however powerful and experienced the animal may be, and I have witnessed three or four instances in which a panther has been deprived of its legitimate prey and routed from its hard-earned kill or even massacred by the combined onslaught of wild dogs.

Though not exhibiting the magnificent lines of a full grown tiger a panther has perfected its symmetry of form, grace and agility, and it has been considered the 'embodiment of the ideal of a beast of prey'.

The average size of a full grown male panther, in Mysore State, is between 6½ and 7 ft., a forest panther being generally better built and larger in size than its village counterpart. Dunbar Brander gives the average size of a forest panther as 7 ft. 5 in. Burke has recorded a panther 8 ft. 5½ in. in length stated to have been shot at Bandipur in Mysore district by A. G. Arbuthnot, one of 7 ft. 10 in. shot by R. R. Lewis at Bellary, and another of 7 ft. 3 in. shot by H. Norman in the Nilgiris. But, to-day, a panther of about 6½ ft. in length may be considered a good average for Mysore State.

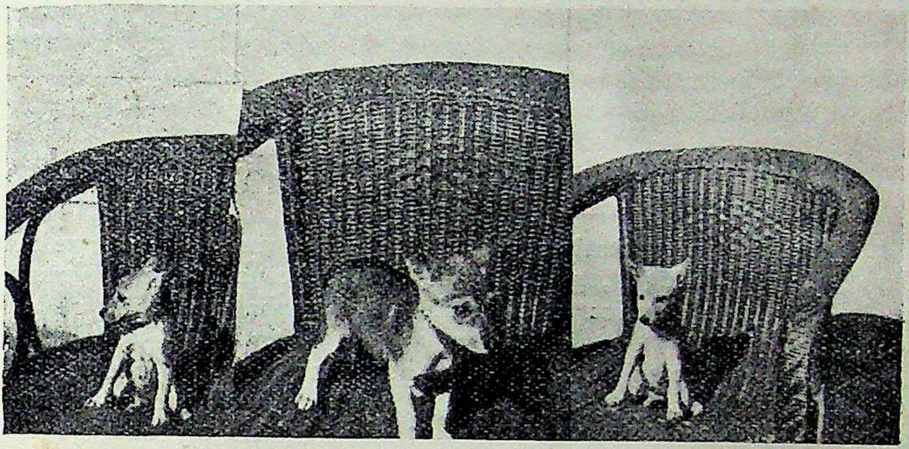
DEHRA DUN, U.P.
November, 1952.

K. KADAMBI, D.SC.
Mysore Forest Service

3. A CROSS BETWEEN THE DOMESTIC DOG (*CANIS FAMILIARIS*) AND THE FOX (*VULPES BENGALENSIS*)

(*With a photo*)

Crosses between domestic or wild dogs and wolf or jackal, or fox, are commonly reported, more frequently between jackals and dogs. Hybrids between jackals and wild or domestic dogs are reported earlier in this *Journal* by Mr. C. H. Donald and Lt.-Col. Burton, etc. Sportsmen have often noticed dog-like jackals, later identified to be hybrid dog-jackals. Blanford once expressed the opinion that the



5-week-old dog-fox hybrids

common Indian pie-dog may be in part descended from wolf or more likely from jackal, and the editors of this journal added that the jackal-like appearance of many pariah dogs seemed to indicate that cross breeding takes place between dogs and jackals.

The accompanying photo shows five-week old hybrid dog-foxes. A vixen which has been kept as a pet from the size of a rat by Prof. J. P. Joshua, was found to be friendly with his dog, whose mother is a pedigree Alsatian and father a Bull-terrier, and he himself has a Dalmatian fur. They were successfully mated and three young ones were brought forth on the morning of the 14th of February, 1953. Two of them are males and the other a female.

For all practical purposes they look like dogs, but they resemble the mother vixen in two respects. Firstly, in preferring darkness and avoiding bright light, and in being active at night, rather than during the day, and secondly, in attempting to howl occasionally when they are in distress. Unlike the dog, the young ones have a bushy tail which is not curved. Donald has reported a set of hybrid jackal-dogs to have the innate fear for man, which is not observed in these pups, but they are extremely playful with their master just like their mother.

It is common for the members of Canidae, especially dogs and jackals, to regurgitate food for the benefit of young ones up to six weeks. Such regurgitation was noticed in this case only after the sixth week, apparently when the mother felt that the young ones were not properly suckled.

Whether the offspring will be sterile or fertile when interbred, or when crossed with the dog or the fox, is yet to be seen. Such interbreeding between jackals and dogs is probably of natural occurrence in the outskirts of jungle villages, but fertile crosses between foxes and dogs are comparatively rare.

DEPARTMENT OF ZOOLOGY,
MADRAS CHRISTIAN COLLEGE,
TAMBARAM,
May 20, 1953.

P. J. SANJEEVA RAJ

4. WILD BUFFALOES AND TAME

I refer to your quotation from Captain Baldwin's 'The Large and Small Game of Bengal', given in the Miscellaneous Notes of Volume 51 (1) at the conclusion of Mr. R. P. Noronha's account on the above subject.

I have had occasion during the last three years to make fairly extensive enquiries in this connection in and around the sanctuaries and forest areas of Assam, and in certain respects my findings disagree with those of Captain Baldwin. I found, for instance, that the Assamese and the Nepalese herdsmen of Assam have a very marked dislike for wild bulls associating with domestic herds for the following reasons:—

(*a*) As soon as a wild bull starts associating with a domestic herd he immediately kills the domestic bulls, which prevents the herd being kept up as explained in (*b*) below.

(*b*) As a result of wild bulls mating with domestic cows, approximately 90% of the calves are still-born. Why this is so I have been unable to ascertain and you may be in a position to throw more light on the subject, but I should like to quote J. W. Best who says in his 'Shikar Notes': 'Wild bulls frequently take over the mastery of a domestic herd, and although they mate with them, the calves are said to be still-born and the cows die at their birth'. Best was talking about wild buffalo in Madhya Pradesh and I found his remark equally true about Assam, although my enquiries did fail to corroborate that the cows also usually die.

(*c*) As stated by Captain Baldwin, such wild bulls often lose their fear of man and sometimes even become killers, not hesitating to attack on sight any human being who tries to approach the herd they have taken possession of. This feature, besides being fraught with grave danger for the herdsmen, makes it almost impossible for the domestic cows to be milked and picketed. A noteworthy point in this connection is that it is usually a young bull, driven out of a wild herd by a stronger bull, who begins to take an active interest in domestic cows, but occasionally one also comes across an old animal taking a similar but more casual interest after having been ousted from a wild herd by a strong 'up-and-coming' young bull.

In conclusion I should also like to state that I had opportunities to see a few mature cows who were the product of wild bulls mating with domestic cows. These animals were invariably very conspicuous in their herds by virtue of their size, heavy build, exceptionally large horns and, on closer observation, very much bigger hooves.

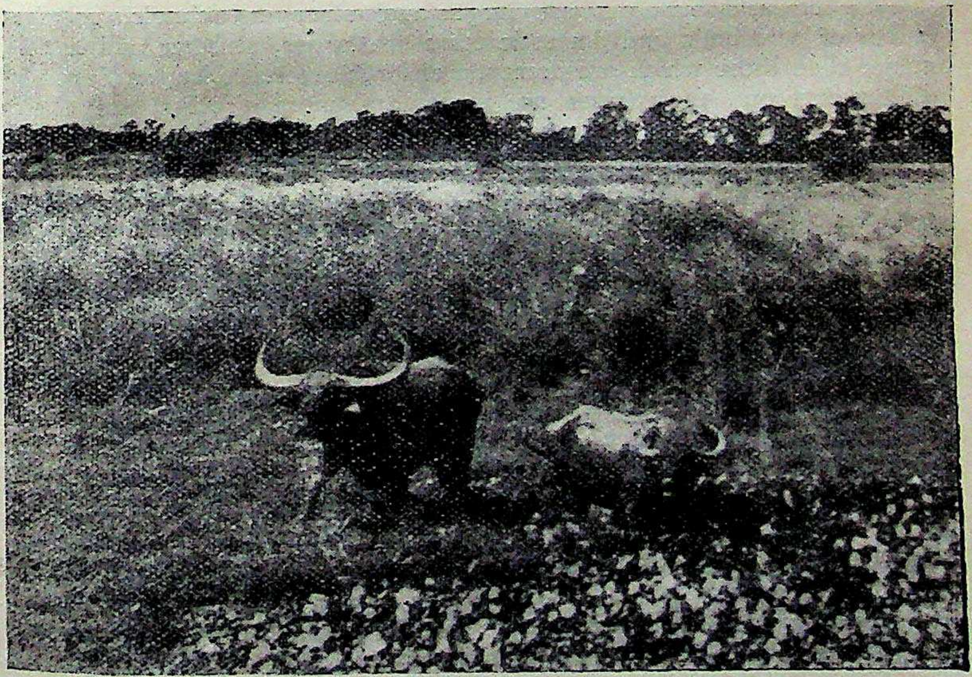
Post Box 139,
Bombay-1, SURENDR LALL
March 25, 1953.

5. WILD BUFFALOES AND TAME

(*With a photo*)

With reference to the note on the above subject by R. P. Noronha, the quotation from Captain Baldwin and the interesting comment on these two by Surendr Lall [above], the following observations may be of interest. They are the result of some 16 years' study of this problem in those parts of Assam where herds of domestic buffaloes are grazed in close proximity to wild ones.

Firstly, I do not think it right to presume that the solitary wild bull buffalo which joins up with a herd of domestic ones has in all cases been driven out from the wild herd by a stronger bull. As in the case of elephants and gaur, the solitary bull buffalo may have left the wild herd of its own free will: the advantages to it of such a course are obvious—a harem with little or no rivalry! I agree with Surendr Lall that the solitary wild bull buffalo mixing with domestic herds may be either an old or a middle-aged animal.



Wild bull buffalo with domestic cow near Kaziranga Wild Life Sanctuary, Assam

Captain Baldwin seems to have contradicted himself by saying first that 'The Assamese keep no tame bull buffaloes so they are dependent on the wild bulls for keeping up the breed', and later that 'We have frequently shot these bulls at the request of the villagers'. Surendr Lall is correct in stating that the owners and herdsmen of domestic buffaloes in Assam strongly dislike the wild bulls coming into their herds. But they have no option in the matter. They cannot keep a domestic bull in such circumstances, for if they do it instantly gets killed or driven away by the incoming wild one. The wild bull also usually chases away herdsmen, and often follows the domestic herd up to the picketing lines and thereby prevents milking.

With regard to Surendr Lall's belief that approximately 90% of the calves of wild bulls and domestic cows are still-born, and his reference to J. W. Best's statement that the cows die at the time of calving (in Madhya Pradesh), these statements need qualifying, I think. Enquiries made by me have shown that about 75% of such calves die between birth and eight days after birth, because the domestic cows have not sufficient milk to feed the half wild calf, owing to the poorer grazing than that enjoyed by the wild ones. Of the cows themselves details are not available, but I have been told that the smaller sized domestic cows often fail to conceive, or else if they conceive they die at the time of calving. The bigger and stronger domestic cows conceive more easily, and usually survive the ordeal of producing a calf larger than normal.

As the wild buffaloes are larger and stronger animals, so the calves of wild bulls and domestic cows are larger, sturdier and handsomer than those which are domestic on both sides. Also, as Surendr Lall points out, their horns are larger and more circular, and their hooves bigger.

A point which seems to have been missed is the marked decrease in the milk supply of cow buffaloes which have been bred from a wild bull. The owners and herdsmen on the north and south boundaries of Kaziranga Wild Life Sanctuary in Assam recently informed me that the milk supply of cross-bred cows drops by a half, from 1-1½ seers to ½-¾ seers per day per cow. These cows of mixed descent are also reported to give trouble to the herdsmen at time of calving.

On the other hand A. J. W. Milroy, a former Conservator of Forests of Assam and an ardent wild life conservationist, believed that the milking capacity of cross-bred cows was actually greater. In a report on the year 1935-1936 he wrote '. . greater encouragement given to the breeding of the half-wild stock (i.e. the domestic herds which are loosely grazed near the haunts of wild ones) for which Assam has always been famous, and which needs crossing with the wild bulls from time to time to preserve its size and milking qualities'. More investigation is needed on this point.

Previous articles and notes in the journal of this Society have usually dealt with the shikar aspect of buffalo. In these more enlightened times, when the camera and the note-book have largely replaced the rifle, a complete ecological study of the wild buffalo seems called for.

A great deal of observation in the different parts of the country where the wild buffalo is still found needs to be done, in order to produce a complete assessment of the advantages and disadvantages of wild blood in herds of domestic buffalo. The opinions of stock-breeders, agriculturists and veterinary surgeons should also be sought.

In order to make the task easier for the staff of the Forest Department, buffalo owners, herdsmen and other persons interested in this subject, I have compiled the following questionnaire which may be of some use.

1. The wild bull buffalo.
   - (*a*) Is the solitary wild bull which leaves the wild herd usually a young bull? or a middle-aged one? or an old one?
   - (*b*) Is it usually ousted from the wild herd by a stronger bull? or does it leave the wild herd of its own accord?
   - (*c*) Are there occasions when more than one wild bull joins a domestic herd? If so, with what result?

2. Behaviour of the wild bull.
   - (*a*) Does it always kill or chase away the domestic bulls?
   - (*b*) Does it always chase and give trouble to the herdsmen and milkers?
   - (*c*) Does it always return to the jungle at the end of the day? or does it wait outside the picketing lines till morning?

3. Seasons.
   - (*a*) Do the wild bulls join the domestic herds at all times of the year? or during special seasons?
   - (*b*) Do domestic buffalo come into 'season' more in certain months than in others?
   - (*c*) What is the period of gestation, and when are calves usually born?

4. Domestic cows served by a wild bull.
   - (*a*) Do all cows conceive? or only some? If so, which ones?
   - (*b*) Do any cows get injured or die at time of service? If so, what proportion, and why?
   - (*c*) Do any cows die at time of calving? If so, what proportion, and why?

5. The offspring of wild bull and domestic cow.
   - (*a*) Do all calves survive? If not, what proportion die?
   - (*b*) Are the calves always larger and stronger?
   - (*c*) What other differences are apparent in these calves?
   - (*d*) If the calf is a female, when grown up is the milk supply greater or less than that of a purely domestic cow? By what amount?
   - (*e*) Does such a cross-bred cow give trouble at time of calving? or at time of milking?
   - (*f*) If the calf is a male, when grown up does it fetch an equally good price as a purely domestic animal when sold?

(g) Are there any other advantages or disadvantages of wild blood coming into a domestic herd? If so, what are they? And do the advantages outweigh the disadvantages, or vice versa?

It is suggested that, with the approval of the Conservators of Forests, all reports collected through personnel of the Forest Department should be sent to the respective Divisional Forest Officers, copy to Mr. E. P. Gee of Doyang T.E., Oating P.O., Assam, who will be only too pleased to compile all information thus received.

DOYANG TEA ESTATE,
OATING P.O.,
ASSAM,
April 25, 1953.

E. P. GEE.

6. CANNIBALISM IN HEDGEHOGS

The hedgehogs, *Hemiechinus auritus collaris* Gray and Hardwicke, and *Paraechinus micropus* Blyth are found in abundance in this semi-arid region of Rajasthan. During my studies on their embryology I have collected a large number of them. In the laboratory I keep them in wooden cages of large size, in which a trial has been made to provide them with more or less natural conditions. The cages are kept in well ventilated rooms where plenty of air and light can be had.

In August-September 1952, when their breeding season was over the females were caught from their respective burrows along with their young ones. Many of the latter were in the 'closed eye' and suckling stage. But they possessed a remarkable power of rolling up; they used to lie during the day as a ball of spines, the young being born with spines.

Once our servant totally forgot to feed them for about a week, so the hedgehogs were very hungry and famishing. One evening two of them were noticed attacking a young one which was on the move. The points of attack were the posterior limbs, which were later chewed. The young made a pathetic noise which was not very easy to hear. After a short while the attackers succeeded in getting the young unrolled and started eating the abdomen. Three others joined them. I cannot, however, ascertain whether the mother of the young was also among these, since the body of a hedgehog is so covered with spines that it is very difficult to tell the sex just by looking at one.

The other night a hedgehog, *Hemiechinus a. collaris*, died a natural death. Next morning I observed that both the species, *H. a. collaris* and *P. micropus*, were busy breakfasting on the carcase. In January 1953 I fed them on a dead specimen with its abdomen cut open. Most of the hedgehogs present in the cage relished the viscera.

Thus both types of cannibalism are present among hedgehogs: feeding on a dead companion, and killing it and then feeding on it.

However, when properly fed the animals do not, usually, molest one another.

BIRLA COLLEGE, PILANI,
April 24, 1953.

ISHWAR PRAKASH, M.SC.
Research Scholar

7. A COLOUR VARIATION, AND ALBINISM IN THE GIANT SQUIRREL—*RATUFA INDICA*

Subsequent to the publication of 'Races of the Indian Giant Squirrel' (*J.B.N.H.S.*, Vol. 50, pp. 467-474), we have had the opportunity of examining 89 additional specimens collected by the Mammal Survey and recently returned to Bombay by the British Museum.

While they fully confirm our conclusions, a specimen (male) collected by J. Riley O'Brien at 3,000 ft. elevation, 5 miles north of Gungavadori in the Palni Hills (whence no others were collected) represents either an individual or a local colour variation.

It differs from *maxima*, which occurs in the neighbouring areas, in having the sides of the body more reddish brown, and which colour in varying shades is prominent on the face, between and behind the ears and also on the fore and hind feet. The tail is not completely black as in *maxima*, but has a large amount of dark reddish-brown patchily distributed between the base and the tip, which are both black. The forehead patch and the ear-tips are also darker than in *maxima*. The label reads 'occurs in evergreen jungles on the slopes and not at Gungavadori itself'.

It may also be of interest to record an albino obtained by Jamshed Panday at Mahableshwar (Western Ghats) 4,000 ft., Satara District, Bombay, on 29th December 1952. The specimen had pink eyes and is pure white as compared to the normal coloured eyes and dirty-creamy white of *dealbatus*. Other normal coloured squirrels were noted in the same locality.

114, APOLLO STREET, FORT,
BOMBAY,
April 27, 1953.

HUMAYUN ABDULALI
J. C. DANIEL

8. JUNGLE NOTES FROM SOUTH INDIA

While out on shikar a few days ago my daughter and I observed an interesting incident.

A cow elephant, with a very young calf, was browsing in a grass patch just below us late in the afternoon. Suddenly it swung round and made repeated short rushes at an animal in the grass, trumpeting and keeping its calf behind it. Then we heard a roar and realised the intruder was a tiger, which, we thought at the time, appeared to be attacking the elephant and its calf. The whole proceeding only lasted a few minutes and the elephant and tiger then departed in opposite directions. We later found the tiger, or rather tigress, had four cubs with it; and both mothers had obviously been keeping each other away from their young!

The tigress and her 4 cubs made a pretty picture a day or two later, basking in the sun in short grass on a hill-top (5,500 ft.). The cubs climbed all over their mother and played while she lay on her side or licked them and herself alternately.

2. On our way back through a shola, along an elephant path, we found ourselves being sedately followed by a tusker—which was quite unaware of our presence on the same path!

3. We saw 5 vultures in the morning poised motionless in the air just above our heads in the teeth of a heavy east wind—just as one sees kestrels do. They remained so for about an hour or more. I have not seen this happen before; there was no kill in the vicinity.

HONNAMETTI ESTATE,
ATTIKAN P.O.,
VIA MYSORE,
(SOUTH INDIA)
March 6, 1953.

R. C. MORRIS

9. MYSTERY PREDATOR

Some friends of mine on a tea estate nearby (in the central Assam plains, not far from the Naga Hills) had the misfortune to lose their goose the other night. The circumstances were rather peculiar.

The following morning the door of the out-house, in which the goose had been sitting on her seven eggs for about two weeks, was found open, and a trail of feathers showed the direction in which some wild predator had carried off the goose into some jungle close at hand. The actual goose was never found. No tracks of any wild creature were found, but the ground was very hard at the time.

This in itself is an ordinary occurrence. But six of the eggs also disappeared, one being left in the nest. Of these six eggs, one was found next day buried in the vicinity, but uncovered by earth. The other five eggs were found during the next few days, all in different places about 50 yds. to 100 yds. from the out-house, cunningly buried in the ground.

I have never heard of such burying of eggs by any wild predator. Perhaps some other member of the Society may be able to throw some light on this mystery?

DOYANG TEA ESTATE,
OATING P.O.,
ASSAM,
April 26, 1953.

E. P. GEE

10. THE AHMEDABAD TENT CLUB IN EARLIER DAYS

The records of this Tent Club, in four bound and padlocked volumes covering the years June 1858 to June 1931, (with a gap of 7 years previous to this) have been deposited in the library of the

Bombay Natural History Society since 1928. The occasion is stated in the Society's journal Vol. 29, p. 1040.

In the first volume we read that on the 10th January, 1859, the Hunt met at Dohnao and killed two boars. Eleven spears were present, among them General Roberts and Lieutenant Roberts. Very seldom were initials entered in the records so we can only surmise that the General Roberts and Lieutenant Roberts out that day were in all probability the famous Field Marshal Lord Roberts and his father. Lieutenant Roberts was out on other days for several years, but the General only on that one day.

The Honorary Secretary from June 1858 to March 1859 was Lieutenant P. H. LeGeyt who was an outstanding pigsticker, as he took 'first spear' during all the Meets of that period. Hadow was the runner-up on several occasions, and other prominent names were Coulson, Bulkley, Propert, Percival, Pottinger, Fasken and others. On the 15th January 1859 Hadow's hunter 'Diamond' fell down dead at the death of the first of the two boars killed that day. Both first spears to LeGeyt. The Hunt shikari, Buka, was awarded sixteen rupees from the funds for those two pig.

For some years the boars killed were entered in the records according to estimated ages, and it was not until 1868 that heights in inches were adopted. Of the six fighting boars killed in the season 1872-73 one was 37⅓ in. and another 36 in., and all the first spears in that year were taken by Surgeon R. Bustead. On 3rd May 1872 Boustead's horse was so badly ripped by a wounded boar which got beneath his body that he had to remain in the jungle for 17 days. During the Season 1874-75 seventeen pig were killed and D. G. Mackenzie secured nine first spears. A number of the boars killed by the Hunt at that time measured 33 in.

On 6th May 1874 Lieutenant Auchinleck, R.A., was out with two others, Major Oldershaw and Lieutenant Stacey. Perhaps that Auchinleck was the father of the distinguished soldier who became Commander-in-Chief of the Army in India.

The volumes contain spirited water-colour paintings and pen and ink sketches of various Hunt incidents. One of these is of a horseman taking a purler over his horse's head to perhaps land on the back of the fleeing boar, for it looks like that; while another depicts the rider being swept from his saddle by the branch of a tree, to the evident astonishment of his mount! During a run on 31st March 1871 the galloping horsemen had to drop 8½ ft. into a sunken road. The scene is well depicted in a spirited water colour showing the horses dropping into the road and the hunted boar fleeing in the near distance. On a day in March 1871 is recorded the unusual occurrence of a 30 in. boar of estimated age 4½ years having died 'squeaking'. Perhaps his near ancestry had some village porker blood!

Some of the records are couched in amusing terms. 'The pig rolled over and appeared to be a "gone coon", when by a great effort he got on his legs, considered a moment, and found his way through an adjoining hedge. His subsequent fate is buried in mystery, and may well act as a "caution" in the way in which a pig will often, at the last moment, evade the most vigilant enquiries of his anxious friends!'

There were plenty of accidents and injuries. 'As Mr. Bulkley approached on a shy young horse the boar charged, and evading the spear planted his tushes deep and wide in the calf of the rider's leg, fortunately without unseating him.' The narrative of the 1859 Christmas Meet occupies twelve pages of the journal. At the close is entered by W. H. P. (Propert) '(N.B. The above talented journalist has this moment left for Kurrachee.)' The gallant fight put up by one of the boars is well told. After describing the finding of the boar and the damages he inflicted on several of the horses, 'It would be tedious to relate the many charges that were made and received, and the spears that were broken by this gallant boar before he received his quietus. Bleeding from a dozen wounds and bristling with broken spears he still shewed an undaunted front; and when he died at last it was in sullen silence and not a squeak betrayed that his last moment was come.'

The sport related by G. E. Hancock in a letter (28-2-67) to the Honorary Secretary deserves further record. After describing some blank days and the losing of several boars he wrote, 'At last I was closing on him in a thick cotton field when the horse's legs caught in the cotton and castor-oil stalks and down he came. I flew over his head *taking the saddle with me*, for the girths broke. I was up again in time to see the boar turn down a lane to the left, jumped on my bewildered horse and rode him bare-backed down the lane as hard as he could pelt. The lane luckily led into the open where I saw the old boar making the most of his time for the next cover. Settling myself *well down to my horse's back-bone* I urged him across the open, and just as the boar plunged into another thick cotton field, I collared him. He turned on me so sharp and unexpectedly that, as you, reader, would have done nine times out of ten in such circumstances—I missed him! and, Oh Misery! driving my spear into the ground, split the shaft half way up. Grasping it together, as a drowning man may grasp a straw, I rushed at him again—and this time, prepared for anything. As I came up, he, as I expected, charged desperately—down went my spear between his shoulder blades where neck and body join—First Spear and Last Spear for it rolled him over dead—and thus I broke my luck.'

In the Tabular Statement of the Hunt for the year 1864 it is seen that five 'first spears' were taken by Auchinleck. At the foot of the Summary is recorded,

'The Hunt met 20 times, and killed 27 Boar. *Vivat Regina*'

BANGALORE,
April 5, 1953.

R. W. BURTON
Lt.-Col. I.A. (Retd.).

11. ERADICATING BATS FROM BUNGALOWS

I was interested to read Mr. R. M. Aldworth's note in Vol. 51 (2) under the caption 'A Novel Method of eradicating Hornets'. By strange coincidence, the same method is adopted in Mandla (Madhya Pradesh), but for a different house pest. In this case the pests were not hornets or bees but they were the small insect-eating bats. In 1924, the D.F.O. North Mandla's bungalow was infested with a large number of these bats. Apart from disturbed nights, the musty smell was over-powering, and in the morning the building floor was littered with their droppings. Realizing my trouble, a Gond orderly cut and collected the thorny branches of wild 'Ber' (*Zizyphus*) bushes. This plant has recurved spines, closely grown all over the branches, and the orderly fixed them up without using any twine or ropes under the roof, at all likely entrances or exits. After sunset these bats tried to get out of their roosting places and there was regular screeching for a long time from each and every bat. As we know, bats' wings are made of membranous skin with a network of nerves, and the recurved spines inflicted very painful wounds. Bats left the bungalow completely from that day.

I think, this experiment is worth trying on fruit bats (flying foxes). Messrs. I.C.I. (India) Ltd., have advised Mr. E. P. Gee to use 10 lbs. of Opencast Gelignite with a No. 6 Detonator. No cost is given for one charge of this explosive. On the other hand, one man can collect enough thorny branches to cover the crown of a fruit-bearing tree. Owing to the recurved nature of 'Ber' thorns one has only to hurl these branches at random on to the crown of the tree without tying them up. In South American orchards they cover each tree with a net during fruiting season. In this method of protecting fruits, they found that the bats learned to creep up the tree over the stem bypassing the net.

But in my opinion if thorns are used instead of expensive nets or dangerous explosives, the problem of getting rid of flying foxes can be effectively solved.

SECUNDERABAD,
June 14, 1953. S. R. DAVER

12. WHY DO DEER AND OTHER MAMMALS LICK EARTH

R. A. McCullough, Research Associate in the University of New Hampshire writes—

'We are trying to ascertain why deer frequent non-saline brackish licks in New Hampshire. We have arrived at the conclusion that it is not due to inorganic matter through the use of the spectograph. We are now doing organic analysis.

There is some evidence accumulating here that there is a sex selective factor in the use of these licks—namely, that the females make much heavier use of them than do males. Have you observed this in India?

I have only been able to find two references to the effect that non-ruminant animals have been observed at these licks—one observation each of a bear and a porcupine. Do non-ruminant mammals or birds frequent your licks?'

Elephants and tiger are recorded in previous journals eating the earth of 'salt' licks as an aperient. (R. C. Morris, xxxviii: 385;

T. Hubback, xl: 730.) Members are invited to send in such further information as may be available.

114, Apollo Street,
Bombay,
April 2, 1953.

EDITORS

13. THE PIED MYNA AND BANK MYNA AS BIRDS OF BOMBAY AND SALSETTE

When writing on the birds of the Bombay Island and Salsette (1936), we did not refer to the Pied Myna (*Sturnopastor contra*). It is a bird of northern and eastern India, not ordinarily found west of Hyderabad in the Deccan or south of Masulipatam in the Kistna District.

In 1940, however, we recorded a pair of Pied Mynas frequenting a part of Dharavi near Sion Station, Bombay. (*J.B.N.H.S.*, Vol. 42, p. 191.) Subsequent to this another pair was noted on the Dharavi-Kurla road on 6th November 1942, followed by pairs or parties in December 1943, September 1949 and February 1951.

On 12th May 1951, a pair started making a nest in a peepal tree adjoining a godown at Dharavi. The nest was of the usual globular type, about 10 ft. from a house crow which was sitting on eggs. Heavy rains, however, washed out the nest and the birds disappeared. On 16th August 1951 a pair with fully-fledged young was noted at Kurla, and this year (1953) a pair again nested in the same peepal and hatched three young.

The furthermost record from this centre so far is of a solitary specimen seen among a flock of Jungle Mynas (*Aethiopsar fuscus*) at Powai Lake (about 5 miles north of Dharavi) on 21st June 1941.

It therefore appears that a few birds, doubtless originating from escaped cage birds, have definitely established themselves around Sion and Kurla, and it would be interesting to see how far they extend themselves and in what time. Several species of mynas have become established in different parts of the world, having been originally taken there as pets.

The status of the Bank Myna (*Acridotheres ginginianus*) around Bombay is also curious. In 1890 Barnes recorded that he saw them 'in the city of Bombay busily employed in excavating holes in the embankment of the Wodehouse Bridge near the Railway Station at Colaba; they did not, however, breed there as the boys persecuted them too much'. In 1900 there was a severe drought in Gujarat where the Bank Myna is common. A few were then noted around Bombay together with a number of other unusual birds which were driven far south of their accustomed haunts in search of a livelihood. During the last 50 years there has been no other record of this species, but in June 1953, V. C. Ambedkar, a young ornithological enthusiast from Poona who was visiting Bombay during his vacations, reported a nesting colony from Bandra. According to him a small number have nested in the same place for the past two or three seasons. Upon investigation we discovered about six pairs nesting in holes in a well in his compound near the Fisheries Department's tank alongside of the main Godhbunder road. The nests contained fledglings and full-fledged young.

BOMBAY NATURAL HISTORY SOCIETY,
BOMBAY,
June 20, 1953.

HUMAYUN ABDULALI
SÁLIM ALI

14. THE TIBETAN SISKIN [*SPINUS THIBETANUS* (HUME)] IN NEPAL

On January 28th last year while picnicing at Godarvari, 5,000 ft. at the foot of the jungle-covered hills in the south of the Nepal Valley I saw a large flock of small finches in the alder trees (*A. nepalensis*). They were feeding on the cones of these trees, but whether picking out the seeds or catching insects of course I could not see. I had a very good view of them. The males with bright yellow breasts were in the minority, the heavily streaked females must have outnumbered them by at least 4 to 1. I should think there were about 80 birds, probably more. They were very like the Scottish siskin and kept up a continual twittering. I did not see them again until April 4th this year when we had 2 days' holiday for Easter and camped on Sheopuri to the north of the valley at 8,400 ft. Early in the morning a small flock of about 15-20 of these finches appeared in a flowering rhododendron just in front of our tent. Against the sky it was impossible to make out any colour, but the small pointed bill and forked tail were unmistakable. My husband shot one, and it proved to be a female Tibetan Siskin (*Spinus thibetanus*). Sir Norman Kinnear who kindly identified the skin at the British Museum, tells me that this is the first record for this bird in Nepal. Next morning they appeared again at the same time. They would all alight in a rhododendron tree, feed for a few minutes, twittering all the time, then as if at a signal they would all rise together and fly on to another tree. They followed the same route both mornings. Again females greatly outnumbered the males.

KATHMANDU,
April 28, 1953.

DESIRÉE PROUD

15. THE DISTRIBUTION OF THE GREENBILLED MALKOHA (*RHOPODYTES VIRIDIROSTRIS* JERDON)

On 6th March 1948 while in camp with the Gujarat Ornithological Survey at Pandwa, Surat Dangs, I shot and lost a specimen of the Small Greenbilled Malkoha (*Rhopodytes viridirostris* Jerdon). Apart from the very clear view I had of the bird, a few feathers were picked up and they confirmed the identification.

On 10th May 1953, I saw one fly across the road in the forest below Karnala Fort, Pen Taluka, Kolaba District, (North Konkan).

It has apparently not been recorded from the West Coast, north of Belgaum (Butler) and Ratnagiri (Vidal). Therefore, the above observations would extend the known range of the species.

c/o Faiz & Co.,
75 Abdul Rehman Street,
Bombay,
May 15, 1953.

HUMAYUN ABDULALI

[The Greenbilled Malkoha has evidently a much wider distribution in Western India than the Fauna implies. More recently (17-7-1953) Rev. E. M. Shull procured a specimen at Mulchond in the Surat Dangs,—a female in breeding condition. The Gujarat Ornithological Survey noted the species also at Ajwa in the environs of Baroda City, and we have records from Daulatabad, *ca.* 100 miles east of Nasik.—Eds.]

16. COMMON GREY HORNBILL (*TOCKUS BIROSTRIS*) EATING FRUITS OF THE YELLOW OLEANDER (*THEVETIA NERIIFOLIA*)

Apropos of Mr. M. Krishna's note in Vol. 50, pp. 943-944, of this journal, I should like to bring to your notice that I have observed the Common Grey Hornbill eating the fruits of Yellow Oleander.

On 12th September, 1946, two pairs of Common Grey Hornbills were in our compound in Kavasseri (Malabar Dist.). One of the birds flew to a thicket of the yellow oleander (a very common hedge plant hereabouts) and straightaway picked a green fruit. Holding it near the very tip of its bill, the bird began to roll the fruit about, dexterously separating the pulp from the stone on one side. Then, as it turned the drupe about to remove the pulp on the other side, the fruit slipped off. With surprising skill, which one would hardly expect of this clumsy bird, it just dipped its head, caught the falling fruit in mid-air, and calmly resumed peeling. When about three-fourths of the pulp had been removed, the bird let the stone drop. Raising neck and bill vertically, it jerked its head sharply downwards, and swallowed the pulp. This is the only instance recorded in my notes, but I think on three or four other occasions I have seen the same thing.

Koels (*Eudynamis*) have often been found resorting to bushes of Yellow Oleander and lingering there for a time, but I never noticed if they ate the drupes. That some birds (and animals too?) do eat these fruits fairly regularly is evident from the half-eaten fruits always found at the foot of these bushes.

Government Victoria College,
Palghat,
May 25, 1953.

K. K. NEELAKANTAN

17. JUVENILE BRAHMINY KITES (*HALIASTUR INDUS*) LEARNING THINGS THE MODERN WAY

We discovered the secret of imparting instruction to the young through entertaining sports and games only recently. Yet a couple of young Brahminy Kites that I watched one day seemed to have almost perfected the method. What is more, they did not have any mentors other than themselves.

It was on the 14th of September, 1952. At 5.30 in the evening, I was roaming about looking at birds near a river. A pair of Brahminy Kites in juvenile plumage flew about over a compound, one chasing the other, turning and twisting with the greatest ease and speed. As I watched, the bird which was being pursued dropped from its talons something that fluttered down slowly in the breeze. The binoculars revealed this to be a dead leaf of the jak tree. Even after the leaf had been dropped, the chase continued merrily for a time. When the excitement of the game diminished, one bird flew skimming over the topmost twigs of a jak tree, snatched a dead leaf in its talons as it flew, and rose. Seeing this, the other bird at once gave chase. A couple of minutes later the second leaf also dropped—or was dropped—without in any way affecting the tempo of the sport. After a time, however, one of the birds flew back to the jak tree and, repeating the manoeuvre already described, bore off another withered leaf. Thus the game went on for quite a long time. Never once did either of the kites try to retrieve the falling leaf; they seemed to know quite well that it was of no importance, or that it was easier to pluck another leaf than to get back the fallen one.

Off and on, however, the bird with the leaf bent its head while in flight, and pretended to peck at the leaf as though it were some prey. When for the fourth time, one of the birds plucked a leaf and began the game over again, a Jungle Crow joined, and participated with an enthusiasm even exceeding that of the kites. The crow never pecked at the kite, nor did it try to fly after the leaf when it was dropped. The kite which was chased seemed to invite the crow to close with it, instead of avoiding contact. When a second Jungle Crow flew up to share the sport, each kite took on one crow. But only one of the kites continued to go every now and then for a jak leaf. The cawing of the two crows attracted two more, but meanwhile, one of the kites grew tired of the game and flew off. The other kite continued with all the crows as pursuers. After a time it too decided to call it a day and sailed off silently.

This was undoubtedly a kind of 'organised game' devised by the young kites with the excellent idea of training themselves for life. Perhaps those adult Brahminy Kites which are often outwitted by crows never knew anything about this system of self-instruction when they were young?

GOVERNMENT VICTORIA COLLEGE,
PALGHAT, K. K. NEELAKANTAN
May 25, 1953.

18. THE GREAT INDIAN BUSTARD

I was most interested to read the article on the Great Indian Bustard by Farid H. B. Tyabji in the *Journal*, Vol. 51 (1) p. 276, December 1952, for I feel it is a sort of challenge to all past and present ornithologists who have not recorded these birds in such large numbers. However, it reminds me of an interesting day I spent many years back in 1933. I was out for a drive from Bhavnagar and at Trapaj, 24 miles away, I came upon a drove of Great Indian Bustard. There were about twenty of them and quite conspicuous. The country was open and undulating studded with bushes. I got out of the car to fire with my rifle a .318 W.R. at them which I did from a distance of about 200 yards. At the report of the rifle about 400-600 Eastern Common Cranes flew up from the background; it was a grand sight, bustards flying low in one direction and the cranes in the other, almost in all directions. The Great Indian Bustard is almost extinct in Saurashtra where it was formerly seen everywhere in suitable localities.

DIL BAHAR,
BHAVNAGAR, K. S. DHARMAKUMARSINHJI
April 25, 1953.

[A very plausible explanation of actually what Mr. Tyabji himself may have witnessed.—EDS.]

19. STRANGE HABIT OF TERNS BREEDING ON GODAVARI SAND-FLATS

While looking for details about the Pheasant-tailed Jacana, I found certain notes in my diaries on a peculiar practice of River and Black-bellied Terns (*Sterna aurantia* Gray) and (*S. melanogaster* Temminck) observed at Rajahmundry.

These two species of terns appear to be resident in the locality, indulging only in irregular local movements. I used to pay particular attention to them in the breeding season, and found them nesting in company with the Little Swallow-Plover on the larger sand-flats of the river. In March and April most of these terns went away from the river to the tanks and a marsh near the Rajahmundry railway station, to obtain fish. Though the river itself contained plenty of crystal-clear water, and was teeming with many kinds of fish, the terns, especially the River Terns, flew all day up and down between the sand-flats and the marsh or tanks to fetch fish for their young ones. The marsh is roughly half a mile away from the river, and some of the tanks only a couple of furlongs; a few tanks to which River Terns were found going lay two or three miles away! These birds occasionally fished even in the shallow, miniature pools beside the railway line, competing with Brahminy Kites and crows.

It is roughly from January to April that the terns are found going from river to tanks, etc. for fish. I once saw terns in the marsh busy fishing in September.

The greatest activity is found in the morning and evening. I have seen as many as 50 Blackbellied Terns fishing with feverish haste in a tank some 100 yds. away from the river, in the twilight of evening. In March and April terns returning to the river always had a fish, one or two inches long, held transversely in the bill. Very often a bird flying from the river met this one and there ensued a chase the end of which I could never discover. I did suspect, however, that these were mates and the chase ended in a transfer of the fish from one to the other. After 8.30 a.m. the traffic between river and inland waters slowed down considerably, but never ceased completely. At least one or two River Terns could be seen flying overhead to and fro. In March I have heard the calls of the River Tern overhead as late as 10.15 p.m. even when it was pitch dark.

This does not mean that the terns never took fish from the river itself; I have found both River and Blackbellied Terns catching river fish. Why then did the terns often fly so far as three miles (perhaps even more) when they could have procured enough and more of food a few feet away from their nests? Was fish from pools and tanks taken only for feeding nestlings? Are terns in the habit of feeding even at night during the breeding season? Has this practice anything to do with the comparative abundance of small fish (more suitable for feeding young birds) in the tanks and marshes?

GOVERNMENT VICTORIA COLLEGE,
PALGHAT, K. K. NEELAKANTAN
May 25, 1953.

[This habit of flying long distances to procure fish for mates on nest or nest-young, when plenty of such could presumably be obtained closer at hand, has been observed also in the case of the Whiskered Tern (*Chlidonias hybrida*), e.g. on the Hokra Jheel in Kashmir.—EDS.]

20. OCCURRENCE OF THE PHEASANT-TAILED JAÇANA (*HYDROPHASIANUS CHIRURGUS*) IN MADRAS STATE

I must confess that I was very much surprised to find the two notes on the Pheasant-tailed Jacana in Madras State (*J.B.N.H.S.*, Vol. 50, pp. 406-407 and 947-948). I have come across the Pheasant-tailed Jacana so often and in so many places in the northern half of the State that I would assert unhesitatingly that it is one of the commonest of water-birds in that area (that part of the State which will shortly be the Andhra Province). Here the Jacana is mostly seen in non-breeding plumage, and in small flocks or parties.

However, the first time I saw this bird was in Madura (in the latter half of the year 1944) when owing to mental and physical myopia, I mistook a large flock of these birds in non-breeding plumage for Sociable Lapwings, and promptly wrote to the Society. Fortunately, Mr. McCann, the then Curator, could not quite believe it, and no harm was done. (A warning to those who are too cocksure about their identifications).

This flock remained in Madura for weeks. Then on 3rd April, 1945 I saw two in winter plumage on a tank at Velugubonda (Godavari Dist.).

On 8th April, 1945 I saw a number of small flocks in the Maduranthakam Tank on the way to Vedanthangal. All but two of the birds were in winter plumage, the exceptions being in transitional plumage with long tail.

On 11th January 1947 a flock of 200 or more was seen in the Thantikonta Tank (Godavari Dist.). All were in non-breeding plumage, but quite a number had long tail plumes which did not curve over sickle wise, but resembled the tail of the Pintail Duck.

On 22nd August, 1948, on a marsh near the Rajahmundry railway station, I saw many pairs. Most birds seemed to be in full breeding plumage, but one individual which was closely studied, lacked the yellow on nape and neck. A week later, on another visit, the birds were found very active and vociferous. The local name for the bird is 'thoottu-pitta'.

On 12th January, 1949, there wasn't a single Pheasant-tailed Jacana in the marsh.

There are some of the records gathered from a few volumes of my diary. I am afraid I did not care to note down every one of the dates on which I came across this bird, as during some periods not a day passed without my seeing a few Pheasant-tailed Jacana. Birds in winter plumage used to be found invariably in the summer months in every village tank, marsh, and even on the lily-and-weed pads in water-logged trenches beside the railway lines. The numbers in these cases were never very large. I suspect that this Jacana breeds in the marsh near Rajahmundry railway station, though I never found any positive evidence.

The note-book containing my observations on the birds of the Kollair (or Kolleru, a vast brackish lake near Ellore, W. Godavari Dt.) not being with me now, I cannot give the dates and details about Pheasant-tailed Jacana found there, but I have very vivid recollections of incredibly large flocks in winter plumage which were found wherever we went in March and April.

In my opinion, the Pheasant-tailed Jacana may be listed as one of the commonest water-birds of the Andhra region, and a frequent winter visitor to suitable places like Madura district on the east coast, farther south.

Government Victoria College,
Palghat,
May 25, 1953.

K. K. NEELAKANTAN

21. BREEDING OF *RALLINA EURYZONOIDES NIGROLINEATA* (GRAY) IN THE DARJEELING DISTRICT

On June 5th 1952 I was shown a nest in the middle of a tea bush by one of the coolies plucking leaf. It was about nine inches across, eighteen inches from the ground and made of sticks and dead leaves. In shape it was a shallow saucer and firmly placed in the middle framework of the bush. It contained 7 pure white eggs, one of which I took for identification purposes if the nest should be destroyed.

The following day I put the bird off the nest but was unable to get a glimpse or a clue as to its identity.

On June 21st the bird was sitting closely and I was able to get a view of her from only twelve inches away. She was rufous with olive on the head and back and the flanks were conspicuously barred with black and white. When she left the nest she demonstrated at me by making an extraordinary noise like a hiss of a snake only deeper and more guttural. This was repeated about six times as the bird was making away in the undergrowth. The bird was still sitting on June 24th, but during the night the nest was destroyed possibly by rats as all I found was one egg on the ground with a large hole in the side and bits and pieces strewn over the ground.

I sent the egg to the Bird Section of the South Kensington Museum for identification, and it was confirmed as being that of the Indian Banded Crake, formerly *Rallus superciliaris superciliaris* Gray.

I can find no records of the occurrence of this bird in the Darjeeling District. This nest was found at 3,300 ft. elevation.

TUMSONG TEA ESTATE,
MARYBONG, P.O., W. H. MATTHEWS, M.B.O.U.
via DARJEELING, D.H. RY.,
April 12, 1953.

[B. B. Osmaston has in two successive years found it breeding at Dehra Dun (*J.B.N.H.S.*, Vol. 24, p. 824 and Vol. 26, p. 429). He records that the bird sat very closely on the eggs and pecked at his hand when he put it out. 'All the time she was delivering her attacks she gave vent to a peculiar noise somewhat resembling the swearing of a cat.'—EDS.]

22. OBSERVATIONS ON THE NESTING HABITS OF SOME COMMON BIRDS

In my village in Kavasseri, (Palghat taluk, Malabar) there is a big Kali temple which was sheltered on all sides by a teak and irool plantation till the trees were cut down in 1950. The trees were all about 20 ft. in height, and in most places there was plenty of undergrowth such as lantana, etc. This wood was a sure draw for breeding birds in the months of April, May and June. From 1943 I used to spend many hours almost every summer afternoon in it. Curiously enough, one particular patch of this wood, bordering on a broad footpath, on the northern side of the temple, and adjacent to a road well sheltered by ancient mango trees, was a favourite with every kind of bird nesting here. I have found nests of the Indian Tree Pie, Blackheaded Oriole, Whitebrowed Fantail-flycatcher, Tailor Bird, and Large Cuckoo-shrike; and failed to find the nests of Little Minivet, Common Woodshrike, Whiteheaded Babbler and Iora which I was certain, bred here.

The fact that many of these birds chose to nest within a small area of a large wood resulted in my noticing some interesting facts about their relationship and general behaviour. I shall restrict myself for the present to some of the most outstanding instances of this 'communal' nesting.

In March, 1943, I came across a nest of the Blackheaded Oriole (c/2), one of the Indian Tree Pie (c/4), and one of the Whitebrowed Fantail-flycatcher (c/3). Being more interested in birds' nests than in bird behaviour, I took all the clutches, only casually noticing that all three nests were within fifteen to twenty feet of one another. All the eggs were fresh, but I could not say which bird had laid first. I assumed then that the oriole and the flycatcher had chosen to build within the tree pie's territory for protection.

In 1944, 1945 and 1946 all these birds and many others were found haunting the same spot, but no nests were found. However, I began to realise that during the breeding season Indian Tree Pies and Blackheaded Orioles were a little too often found in company, though occasionally the orioles were really chivying the tree pies.

It was in April 1947 that I got a good opportunity to study the behaviour of these birds at close quarters. On the 25th of April, I found a Large Cuckoo-shrike's nest (c/2) on a tree beside the footpath. While watching this, I kept an eye on other birds in the area, and saw that when one of the Large Cuckoo-shrikes went to chase a crow away, it was eagerly assisted by a Blackheaded Oriole and a pair of Whitebrowed Fantail-flycatchers. This led to the discovery of the flycatcher's nest on the 30th (c/3). On the 1st of May, a tree pie's nest was also discovered close by (4 chicks, a few days old). On the 4th I found the oriole's nest (c/2). It was hardly 30 feet away from the tree pie's; the tree pie's was about 50 feet away from the cuckoo-shrike's; and the fantail-flycatcher's was only 10 feet from the cuckoo-shrike's. The nests were all on different trees.

It was obvious that the first bird to lay eggs was the tree pie. Then the cuckoo-shrike; the flycatcher and the oriole must have followed suit, in that order. For the cuckoo-shrike's two eggs hatched out on the 3rd of May, the flycatcher's on the 6th, and the oriole's on the 12th. All the chicks of the tree pie left the nest and reached adulthood safely. One of the two chicks of the cuckoo-shrike disappeared before the 15th, and the other, I assume, left the nest safely between the 23rd and the 27th of May. The chicks of the fantail-flycatcher disappeared on the 12th, and those of the oriole on the 20th. In both cases they were undoubtedly snatched by some predatory creature, most probably the tree pie itself.

I spent an hour or two every day from the 25th April to the 23rd May near these nests and was able to study the behaviour of these birds to some extent. The tree pie's route to its regular feeding places led away from the oriole's nest, but was well within the 'territories' of the cuckoo-shrike and the fantail-flycatcher. The cuckoo-shrike never attacked the tree pie, though no crow, kite or eagle was ever allowed to pass by in peace. The fantail-flycatchers did not harry the cuckoo-shrikes, but could never tolerate the tree pies. Every time a tree pie flew that way (which was necessarily often), the flycatchers went madly in pursuit. The flycatchers were often assisted by a pair of Common Wood-shrikes, which in turn were frequently harassed by the flycatchers! When the cuckoo-shrike flew at a passing crow, the flycatchers and the orioles often joined it, but the oriole never turned against the cuckoo-shrike, and rarely attacked the tree pie.

At first I could not understand how the nests of the smaller birds remained safe for such a long time within the tree pie's territory. But soon it was discovered that when there were eggs in the nest, the tree pies never foraged in the immediate neighbourhood of their nest-tree. Invariably they flew some 100-200 yards straight east before beginning the search for food, thus leaving a sort of 'sanctuary' round about their nest. When, however, the tree pie brought out its chicks, adults and young wandered about all round the nest-tree. In the course of this, as was inevitable, they must have come across the nests of the smaller birds and rifled them.

In 1948, April-May, another set of nests was found in the same place. On the 30th of April I saw a tree pie being chased by a pair of indignant Blackheaded Orioles and a pair of Large Cuckoo-shrikes. The cuckoo-shrikes attacked the tree pie only when it was on the wing, whereas the orioles dived at it even when the tree pie sat quietly on a branch. In 1947 the cuckoo-shrikes never took any notice of the tree pies.

On the 4th of May I discovered the tree pie's nest (c/4), and 20 feet away, the nest of the oriole. I could not examine the oriole's nest. On the 5th a tree pie and an oriole were chasing a Common Grey Hornbill away from this spot. After the hornbill had escaped, the oriole turned against its erstwhile ally, the tree pie, and followed it until the tree pie returned to its own nest. Observations on these nests could not be continued as I had to leave the place for a short period. On my return on the 26th I found that the tree pie as well as the oriole had left the area.

On 19th May, 1949, I discovered at the same spot the nest of a Blackheaded Oriole containing a single chick, and saw a pair of Large Cuckoo-shrikes of which one bird had nesting material in its bill. On the 21st May a tree pie's nest was found 25 to 30 feet away from the oriole's. There were eggs in the nest. On the 28th the orioles were seen feeding their chick. The tree pie was sitting on eggs. From the 29th of May to the 10th of June I had to be away. On 10th June both nests were found deserted.

So, four times, definite evidence was found that these birds often nest close together. But it appeared to me as though (1) this was due to a common attachment to a particular nesting spot, rather than to the weaker birds' desire for protection; (2) they rarely became reconciled to each other's presence in the area; (3) the tree pie let others live in peace till its chicks hatched; and (4) this was due to the tree pie's habit of leaving at least a hundred yards around its nest unexplored while brooding eggs.

I hope some bird watcher will take up this thread and pursue it. It is quite on the cards that similar favoured spots may exist wherever birds are common.

GOVERNMENT VICTORIA COLLEGE,
PALGHAT,
May 25, 1953.

K. K. NEELAKANTAN

23. MORE ABOUT VIZAGAPATAM BIRDS

In 'Birds of the Vizagapatam District' (*J.B.N.H.S.*, Vol. 45 pp. 333-347) I listed the birds seen during two short visits and drew attention to the paucity of published literature. Subsequent to this I have had letters from Capt. G. Gowland, R.N. and Mr. N. A. Leslie adding to the list, and it might be worth while placing them on record. Except where otherwise stated the information is from Mr. Leslie:—

Uroloncha malabarica (Linn.). The Whitethroated Munia.

'Capt. Geoffrey Gowland, R.N. informed me in June 1950 that he had seen this species near Vizagapatam.'

Motacilla alba subsp. The White Wagtail.

'A flock near Pottangi village, east of Koraput (near Jaypore) in February 1949'.

Motacilla maderaspatensis (Gmelin.). The Large Pied Wagtail.

'A pair near Koraput in December 1948'.

Falco peregrinus:

The bird recorded as a laggar on page 343 of Vol. 45 of the *Journal* is a peregrine. I have marked the bird as of this species on the label and cannot understand how it was transformed into a laggar!

Falco tinnunculus. The Kestrel.

'Frequently seen hunting round war-time coast battery adjoining Vizagapatam Lighthouse—also seen near Koraput'.

Spizaëtus cirrhatus. The Crested Hawk Eagle.

'Between Araku and Anantgiri in February 1949'.

Elanus caeruleus vociferus (Latham). The Blackwinged Kite.

'Identified on lines suggested by Whistler under heading "Pale Harrier" near Koraput'.

Circus macrurus (S. G. Gmelin). The Pale Harrier.

Mr. Leslie saw it at Padwa in December 1948 and I had overlooked Donald's (*J.B.N.H.S.*, Vol. 16, p. 505) note on this species together with Marsh and Pied Harriers collecting to roost on a bare plateau on 13th February.

Larus ridibundus. The Blackheaded Gull.

'Vizagapatam Harbour—common'.

Sterna aurantia (Gray). The Indian River Tern.

'Occasional'.

Charadrius dubius. The Little Ring-Plover.

'Small flock near Tuni' (Tuni is in East Godavari District administratively but on the border of Vizagapatam District).

Lobipluvia malabarica. (Boddaert). The Yellow-wattled Lapuring.
Capt. G. Gowland saw it near Vizagapatam.

Himantopus himantopus (Linnaeus). The Blackwinged Stilt.
'Single bird near Tuni in October 1948'.

Scolopax rusticola (Linnaeus). The Woodcock.

In the *Journal* (Vol. 23, p. 777) appears a note recording a woodcock at Salabam 4,000′ in the Eastern Ghats 18° 10′N./82° 45′E. on 26th February. I have already referred to the Gazetteer records from Padera, west of Sankrametta. Does the paucity of data regarding the movements of the woodcock from the ornithologically better investigated Deccan and Western Ghats indicate that the birds may perhaps reach the Nilgiris by way of the Eastern Ghats?

Capella gallinago (Linnaeus). The Common Snipe.
'Shot. Plentiful near Koraput'.

Pseudibis papillosa (Temm. and Laug.). The Black Ibis.
'Single bird in September 1948 at Chittivalasa near Bimlipatam, 15 miles south of Vizianagaram'.

Dissoura episcopus episcopus (Boddaert). The Whitenecked Stork.
'Plentiful in Koraput/Jeypore area'.

Bubulcus ibis coromandus (Boddaert). Cattle Egret.
'Common'.

A 'List of Duck Shot in Waltair District in 1899' *J.B.N.H.S.*, Vol. 12, p. 575 includes Common and Garganey teal and Comb Duck. *Netta rufina,* the Redcrested pochard (223) tied with gadwall (260) as the commonest duck.

c/o Faiz & Co.,
75 Abdul Rehman Street,
Bombay,
June 25, 1953.

HUMAYUN ABDULALI

24. DOMESTIC POULTRY DISEASES NOW ENDEMIC IN JUNGLE

It is evident that the domestic poultry diseases known as 'Ranikhet Disease' and 'Chicken Cholera' are now endemic in the Reserve Forests of the Kollegal and North Coimbatore Divisions (Madras State), and also in parts of the Mysore District. I have frequently, in the last few years, come across remains of junglefowl, partridge, quail, and occasionally of peafowl. It was obvious that they had not been killed and devoured by predatory animals. As the areas were all not far from cultivation and villages I made enquiries from the local jungle tribe (Sholagas) and my suspicions that game birds were falling victim to domestic poultry diseases were confirmed. Junglefowl can often be seen feeding and consorting with domestic poultry; and are bound to catch the latter's periodic diseases. The majority of dead and sick game birds must of course be picked up and devoured by animals. The very great decrease within recent years of game birds such as junglefowl, partridge, quail and peafowl in areas in which they were once abundant, is thus explained, accentuated as the position is by netting by *pardis*.

HONNAMETTI ESTATE,
ATTIKAN P. O., R. C. MORRIS
via MYSORE, (S. INDIA),
December 31, 1952.

[In June 1953, a batch of partridges containing both the Grey and the Painted, were seized from a professional catcher who was illicitly hawking them in Bombay city. All the birds died within three days, the cause, as confirmed by the Assistant Disease Investigation Officer (Poultry), Bombay State, being Ranikhet Disease. In December (1952) the Society had also received a half-grown chick of the Painted Partridge (*Francolinus pictus*) shot near Kalyan, Bombay. The specimen had white encrustations around both the eyes as also similar patches in the still naked areas under the wing.

In sending the specimen to the Bombay Veterinary College for examination and report, we enquired whether the same disease was seen among poultry, whether it appeared periodically in epidemic form, and if it seemed likely that this partridge chick could have contracted it from domestic fowls of the nearby villages since they may often feed in the same fields. This presumably happens in the case of chicken cholera and 'Ranikhet Disease'.

Prof. R. M. Kalapesi, the pathologist of the Bombay Veterinary College, writes about the infection of the partridge chick as follows:—

'Favus is a chronic dermatomycosis affecting chickens, occasionally turkeys and very rarely canaries and wild birds. It may also occur in mammals including man.

It is commoner in fowls of the larger Asiatic breeds than in the European fowls and more so in males than females, especially in the sixth to the seventh month of life.

It is caused by the Achorion group of Fungi which in birds is *Achorion gallinae* and characterised by the formation of peculiar disc-shaped crusts with depressed centres and known as scutula from their shield-like appearance.

Infection occurs by direct contact with objects containing the fungus. It is also believed that the infection may be carried by air. Young birds are particularly liable to the disease. The disease is generally mild and sporadic in nature, may exist in a flock for several months but few losses directly traceable to it are experienced. Man is susceptible, therefore care should be taken to prevent transmission if an outbreak occurs.

For prevention and control remove and dispose of all the infected birds, move the flock to new quarters and disinfect the place.'—EDS.]

25. BIRD MIGRATION IN INDIA

Since publishing the last record in Vol. 50 (4), p. 949, the following information has been received concerning one more recovery of a Russian ringed bird in India, through the good offices of our Embassy in Moscow :—

No. of ring	Date	Name of bird	Place where ringed	Remarks (adult or young)	Name of ringer	Date of recovery	Reported by	Place where recovered	Remarks
MOSKWA 108651 E	20th July 1949	Garganey Teal	On Lake Marveyevo, Mikhailovski region, Pavlograd Oblast, Kazakh Soviet Socialist Republic	Grown-up male, in the moulting season	Central Bird Banding Bureau, Moscow.	January 1952	C. B. Dube, I.A.S., District Magistrate, Gorakhpur District, Uttar Pradesh.	Shot in the Gorakhpur District, Uttar Pradesh, India.	

114, Apollo Street,
Fort, Bombay,
March 20, 1953.

EDITORS

26. SCENTING POWER OF BIRDS

With reference to Col. Burton's note on p. 675 of Vol. 50. That well known field naturalist Abel Chapman discusses the subject at length in *Borders and Beyond* pp. 421-439, and again in *Retrospect* pp. 150-155. His opinion is that while the vast majority of birds (even Great Bustard) wholly ignore the safeguard of scenting, wildfowl on the water are keenly alive to the faintest clue from scent, though duck and teal in flight, being above the line of scent, are not affected by it. He considers that 'Geese though equally receptive of scent, are apt to await—with rapt attention—some slight ocular corroboration of a risk already revealed to their olfactory senses', and adds that 'of all the duck tribe, teal (though the most simple) are the most keenly receptive of scent'. As is usual with this careful observer, he supports his statements with a number of examples. My own experience with wildfowl is exactly the same. On many occasions I have from a distance spotted duck or teal within easy range of a tank bund. I have then approached under cover of the bund, and provided the wind was right have always found the birds in the same position. Should however the wind be blowing from me towards the birds, then on topping the bund I have invariably found them out of range, either swimming away or already in flight. A particular instance last year at Gundlupet serves to confirm this. Projecting from the main bund of the tank is a curved ring-bund constructed some years ago when the tank was breached. A narrow path along it affords easy and silent access under cover of tall rushes well out into the tank. On the evening in question I wished to pick up a couple of bird for the pot. A recce under cover of the bund showed about 50 garganey some 100 yards away and close to the ring bund. A silent approach found the birds quite undisturbed and at close range, and a couple of shots gave me what I wanted. It may be noted that on this occasion the wind was blowing from the birds towards me. On the following evening I found the birds in the same place, but the wind had now changed and was blowing from me towards the teal. I had scarcely started on my stalk when they all rose and flew away. They could not possibly have seen me as I was very well hidden and the only explanation of their alarm is that my scent was carried to them.

KALHATTI P.O.,
NILGIRIS,
March 10, 1953.

E. G. PHYTHIAN-ADAMS,
Lt.-Col., I.A. (Retd.).

27. ADDITIONS TO RECORDED FOOD ITEMS OF THE BULL FROG (*RANA TIGRINA*)

In December 1952 my attention was attracted to the much swollen stomach of a frog (*Rana tigrina*) when I was injecting Reeve's India ink, into its heart to facilitate the minute tracing of arteries and veins. On cutting open the stomach, I found to my surprise a Fat-tailed Lizard (*Uromastix*) about 10 inches long and a large head of a spider (*Galeodes agilis* Poc.). The lizard was an adult one and was not affected by the gastric juices. It was lying coiled up, the head being nearer to the anal region. The body of the arachnid was digested; only remains being of the head, which was unaffected, because of its chitinous nature. Probably the lizard was captured shortly before the frog was chloroformed.

The capture of the *Uromastix*, by the frog can be explained, because of its sluggish condition in the winter, but the capture of the *Galeodes* is difficult to be explained for it is extremely active and can cover ground very fast, and so at first sight it would appear somewhat strange how such a fast creature should fall a victim to a comparatively slow moving batrachian.

Preying by a large frog on a smaller one is quite common but I do not know whether the *Uromastix* and *Galeodes* are also normally included in the menu of the frog.

BIRLA COLLEGE,
PILANI,
March 30, 1953.

ISHWAR PRAKASH, M.SC.,
Research Scholar.

[Among the varied dietary of the Bull Frog (*Rana tigrina*) the following items have been recorded in notes published in previous journals from time to time—mouse, young ground thrush, fully grown sparrow, chicken, snipe, pitta, land crab, toad, rat snake about 3 feet long, scorpion and the caterpillar of the Psychid moth together with its case of babool spines.—EDS.]

28. NEW LOCALITY RECORD OF *RANA HEXADACTYLA* LESSON

While examining a collection of frogs and toads from Goa, brought in by Mr. L. B. Nogueira, an assistant in the Museum, I came across a number of specimens of *Rana hexadactyla* Lesson in various stages of development.

The distribution of this species is restricted to South India and Ceylon [Boulenger (1890 and 1920) Fauna Volume 'Reptila and Batrachia' 441-42] and his subsequent 'Monograph of the South Asian, Papuan, Melanesian and Australian Frogs of the Genus *Rana*'. *Rec. Ind. Mus.*, xx, 10-12.

Bhaduri (1933 and 1943) recorded this species twice from Bengal [*J.B.N.H.S.*, xxxvi, 514; ibid. xliv, 484] and McCann (1934) has a note on its occurrence in Bombay (ibid. xxxvii, 742). We have in our collection a couple of specimens (donated by Ingoldby) from Waziristan.

As far as is known this is perhaps the first record of this species from Goa and this together with the former ones, goes to show that *Rana hexadactyla* Lesson is not so very limited in its range as is commonly believed, but seems to compete with its congener *Rana cyanophlyctis* Schneid., which enjoys a very wide distribution in Peninsular India. Some more records from varied localities are, however, needed to confirm this.

Rana hexadactyla Lesson owing to its more secretive nature and greater degree of camouflage-perfection eludes observation and capture. Both the species, however, never leave water.

114, Apollo Street,
Bombay,
June 1, 1953.

V. K. CHARI,
Assistant Curator.

29. APOSEMATIC INSECTS AND THEIR FOOD PLANTS

Mr. Sevastopulo's comments (*J.B.N.H.S.*, 50, p. 951) on Mr. Winter-Blyth's remarks dealing with the possible interrelation between aposematic insects and their food plants interested me greatly, and called to mind some observations made in the field some years ago. At the time, I speculated on the possibility of the food plants imparting the protective odours emitted by such insects, but did not commit my observations to paper. I saw no valid reason why the offensive or otherwise noxious properties of the food plants should not be reflected by the individuals feeding on them. How often has it been noted that edible water-fowl when feeding on certain aquatic vegetation are distasteful, which, at other times are delicious? This is particularly true of wild duck.

Some years ago a note was published in the *Journal* describing the 'poisonous' effect on humans who had eaten fish which in their turn had fed on the fruit of the *Kalaw* (*Taraktogenos* sp.). The fish acquire the poisonous qualities only at the time when they feed on the *kalaw* fruit, and are perfectly wholesome at other seasons. Here we have an instance of the food imparting its poisonous qualities to the flesh of the fish without otherwise affecting the fish in the least. Similarly I think it is well-known that the body odours of mankind (apart from the deliberate application of external scents) very often reflect the diet of a particular individual or community. For example, garlic (*Allium ursinum*) or *methi* (*Trigonella foenumgraecum*) if eaten regularly is 'sweated out' and gives a distinctive body odour. Some other edible substances produce the same result. Similarly, people who consume much vegetable oil 'exude' the oil, and the skin looks 'oily'. From such examples it seems clear that the food plays an important part in producing particular odours. Perhaps during the process of digestion some of the odoriferous substances become more concentrated and are exuded through the skin. The constitution of aposematic insects possibly have special means of concentrating these substances and using them to advantage by storing them in special organs or cells. However, here I must leave generalizations and turn to specific instances.

Aularches miliaris: The colouration of this grasshopper is well-known and therefore needs no description. The nymphs of the species display more black and red; the green and yellow markings, are absent. The nymphs, like the adults are gregarious, but more so. They collect in large numbers ranging from fifty to a couple of hundred. Such gatherings may be seen sitting on the leaves of *Heterophragma roxburghi* during the hot and dry weather. They sit on the upper surface of the leaves in full view, but if alarmed they drop to earth and seek shelter on the forest floor. Incidentally *Heterophragma* is perhaps an exceptional tree in the deciduous forests in so much that it is the only tree which is in full leaf when others are leafless, and leafless during the monsoon when all other trees are in full foliage! The black, naked trunks and branches stand out remarkably during the rains, just as the 'silvery' stems of *Sterculia urens* stand out during the hot weather.

The crushed leaves of *Heterophragma*, as well as the flowers and fruit emit a pungent, offensive odour. The nymphs of *Aularches* feed on the leaves of this plant and emit a similar odour when handled. I do not know what the natural enemies of this grasshopper are but it certainly enjoys a certain amount of immunity from predators. Incidentally, *Heterophragma* itself is seldom attacked by insects, but the leaves are subjected to a brown rust.

During the monsoon the adults of *Aularches* feed mainly on the foliage of *Gloriosa superba*. In some years these grasshoppers appear in greater numbers than usual and in consequence extensive damage is done to *Gloriosa*. Whole patches of the plant are defoliated. *Gloriosa* is known to be highly poisonous and the crushed leaves give off a strong acrid odour. The grasshopper, as though 'aware' of its warning colours and its defensive noxious odour, sits in the open and is not easily disturbed; at most, it will 'kick off' into another portion of the bush, and will make no attempt to hide. Although provided with strong wings it is seldom seen in flight. When caught it emits a frothy mass at the base of the jumping legs, at the same time vomiting a blackish liquid, in the same way as many other grasshoppers do under the same circumstances. The smell of the foam is very acrid and reminiscent of the crushed leaves of *Gloriosa* but in more concentrated form. The odour of the vomit is similar but not so volatile. The smell is so strong that the air is permeated with it. As in the case of *Heterophragma*, *Gloriosa* enjoys a fair share of immunity from insect pests.

The interesting part of *Aularches* is that the nymphs and adults feed on different plants and both reflect the odour of the particular species they predominantly feed upon.

Poecilocerus pictus F.: *Poecilocerus* is another grasshopper remarkable for its brilliant colouring. It is always associated with the two species of *Calotropis* (*procera* and *gigantea*). It is more commonly found in the drier areas on *C. procera* than in the wetter regions. I am not familiar with the early hopper stages, but as far as I am aware the insect does not feed on any other asclepiad. Although the animal is brilliantly coloured, the colouring is slightly masked by a soft 'bloom' resembling the bloom found on the plants themselves. It is somewhat heavily built and sluggish of habit—reluctant to move. When disturbed its first attempt to evade the intruder is to move round to the opposite side of the branch. On the whole it is less sportive than *Aularches* and less gregarious, one or two being the usual number on each plant. When handled it emits an odour similar to the bruised leaves of *Calotropis* at the same time vomiting a pungent smelling liquid. As far as I can remember this species does not produce the foam at the base of the legs as does *Aularches*.

LEPIDOPTERA: Among the butterflies and moths there are numerous examples exhibiting aposematic colouration coupled with noxious odours, the odours resembling the crushed parts of the food plants. For example, *Danais chrysippus* reflects the odours of the various asclepiads upon which it feeds. *Danais limniace* larvae feed on the leaves of *Crotolaria* (*retusa*?) and the butterflies themselves collect in vast numbers on the same plants, sometime accompanied by *Euploea core*. *Limniace* has an odour resembling the *Crotolaria*. Many other examples could be quoted, but as some have already been referred to by other authors I shall not labour the subject.

HEMIPTERA: Among the so-called garden- or mother-bugs there are some marked examples exhibiting the similarity of odour between the food plants and the animals themselves. Some go still further by ejecting a smelly fluid. This fluid, should it reach the eye or other mucous membrane, may cause a certain amount of smarting as I have experienced to my cost when out insect collecting at night! Nevertheless, there are some which emit quite a different odour to that of the food plant. I am not attempting an explanation of this phenomenon! In spite of the warning colours and disagreeable odours and perhaps taste (to most birds) the cuckoos feed largely on bugs.

COLEOPTERA: Among the beetles there are also numerous examples showing similar and dissimilar odours to the food plants. To take a single example, the flea-beetle, *Haltica*, feeds largely on *Ammania* and emits the same odour as the plants. That these beetles appear in such large numbers as they do each season seems to indicate that apart from their colouring and their habit of 'kicking off' when alarmed (as many Chrysomelidae do), they appear to enjoy immunity from would-be enemies on account of the odour they emit.

There seems to be little doubt that the odours which protect many insects from would-be enemies are derived directly from the chemical properties contained in the food plants, some of which may be elaborated into other offensive substances during the process of digestion. The change of food plant seems to occasion a change of odour as in the case of *Aularches*. However, there is much to learn of the life-cycle of many of the commoner aposematic insects which might throw some light on the subject, and a careful biochemical analysis of both insect and food plants may produce some interesting results.

DOMINION MUSEUM,
WELLINGTON,
NEW ZEALAND,
December 31, 1952.

CHARLES McCANN, F.L.S.

30. A NOTE ON THE INDIAN SPECIES OF THE GENUS *LYCAENOPSIS* FELDER (LEPIDOPTERA—LYCAENIDAE)

A short time ago Sir Keith Cantlie told me that the key on page 225 of 'Identification of Indian Butterflies' for separating *Lycaenopsis argiolus sikkima* from *jynteana* by the number of ribs on the androconia had been found by Mr. D. F. Sanders to be unreliable. So I looked into the matter.

In the first edition (1927) of the 'Identification' I had treated *sikkima* as a synonym of *argiolus jynteana*. Shortly after the publication, I had been in correspondence with the late L. J. Toxopeus, who published several papers on the genus, and the changes made by him may be summarised thus:—

(1) 1926 *Treubia* VIII: 365. *Lycaenopsis moorei* nov. for the ♀ type of *lavendularis* Moore, found to be a ♂.

(2) 1927. *Tijd. voor Ent.* LXX: 294. *Actyolepis puspa felderi* for the second *puspa* form in Ceylon. He considered that *lilacea* Hampson (=*crissa* DeNicéville) was the *puspa* form from S. India.

(3) Id. p. 120. Regarded *Celastrina jynteana* and *sikkima* as species, the first with 14 to 15 ribs on the androconia and the second with 11 or 12.

(4) 1928. *Tijd. voor Ent.* LXXI: 224. Introduced *lavendularis* as the name for the *limbata* form from Ceylon.

Except for *lilacea* I accept the changes made by Toxopeus as I was unable to check them in India.

Now I have examined the material in the British Museum (Natural History) and, after studying the published literature and dissecting several specimens, I have come to the following conclusions:—

(*a*) *lavendularis* Moore (=*moorei* and *felderi* Toxopeus) is the correct name for the *puspa* sub-species from Ceylon.

(*b*) *lilacea* Hampson (=*crissa* DeNicéville) is the name for the *puspa* form from S. India. Both have strongly marked seasonal forms.

(*c*) *limbata* is a species with sub-species *amitra* Fruh. from Ceylon: sub-species *limbata* Moore from S. India to Bengal: sub-species *placida* DeNicéville from Sikkim to Burma.

(*d*) *sikkima* Moore is a synonym of *argiolus jynteana*, a protean subspecies of the wide-spread *argiolus*, one of whose forms *bothrinoides* was mis-spelt *bothrioides* in the 'Identification'. Dry season forms of *placida*, with reduced markings, are not always easy to separate from *jynteana*.

(*e*) I prefer to retain the generic name *Lycaenopsis* as used in the 'Identification' and deprecate the tendency to split up easily recognised natural groups into a number of genera. For instance the well-known genus *Argynnis* is now left with a single species!

BRITISH MUSEUM (NATURAL HISTORY),
LONDON, W. H. EVANS
May 18, 1953.

31. MORE ON BUTTERFLIES FROM NEPAL

During the course of five months spent with a party of mountaineers under the leadership of Major H. W. Tilman, D.S.O., M.C., in Central Nepal in 1950, I made a small collection of butterflies for the British Museum. The 25 species included in the following list by no means represent the total number of varieties seen, but the list may be of some interest as an *addendum* to Colonel Bailey's 'Notes on Butterflies from Nepal' which was recently published in the *Journal* (Vol. 50: 64-87, 281-298). That the collection is so small is mainly due to the fact that I was primarily concerned with collecting botanical specimens, but is also due to the fact that, in my limited experience, butterflies in the hills are generally encountered flying at high speed down steep hillsides!

The area visited would certainly repay a visit by an experienced entomologist for it seemed to be particularly rich in such orders as Orthoptera, Coleoptera and Hymenoptera.

With a single exception all the localities quoted, above 10,000 ft., are in a dry zone, the upper valley of the Marsiyandi River being protected by the Annapurna Himal which rises to over 26,000 ft., and so effectually protects it from the monsoon.

I am indebted to Mr. A. G. Gabriel of the British Museum for the identifications.

PAPILIONIDAE

1. **Papilio philoxenus** Gray f. typ.

Evans 2.15.

Common among bushes at the edge of fields. Thonje, 6,500 ft., 24-5-50.

2. **Papilio janaka** Moore f. typ.

Evans 4.4.

Common among bushes at the edge of fields. Thonje, 6,500 ft., 26-5-50.

3. **Papilio machaon everesti** Riley.

Evans 4.29.

Sparingly on bare open stony slopes and among dwarf juniper. Jargeng Khola, 15,500 ft., 5-7-50.

4. **Parnassius epaphus sikkimensis** Elwes.

Evans 13.3.

Sparingly on steep grassy slopes. Khangsar, 15,000 ft., 27-7-50.

5. **Parnassius hadrwickei f. correctus** Bryk.

Evans 13.4.

Frequent on open grassy slopes. Jargeng Khola, 14,000 ft., 3-7-50; Khangsar, 15,000 ft., 24 & 27-7-50.

6. **Parnassius delphius lathonius** Bryk.

Sparingly on steep rocky hillsides at great altitudes. Thorongse, 18,000 ft., 6-8-50.

PIERIDAE

7. **Colias dubia** ssp.

Evans 16.8.

Sparingly on grassy slopes. Khangsar, 14,500 to 15,000 ft., 27-7-50.

8. **Colias fieldii** Menetr. f. typ.

Evans 16.11.

Plentiful in grassy places. Manangbhot, 11,500 to 14,500 ft., July to September.

9. **Colias arida** ssp.

Evans ?

On grassy hillsides. Jargeng Khola, 14,500 ft., 2-7-50; Khangsar, 16,000 ft., 29-7-50.

SATYRIDAE

10. **Lethe baladeva** Moore.

Evans 3.2.

Common among bushes at the edge of fields. Thonje, 6.500 ft., 24-5-50.

11. **Lethe nicevillei** Evans.

Evans 3.9.

Dudh Khola, 11,500 ft., 23-8-50.

12. **Raphicera moorei** Butl. f. typ.

Evans 4.6.

Frequent in grassy clearings in forest. Kupar, 8,000 ft., 18-8-50.

13. **Paroeis sikkimensis** Stgr.

Evans 10.2.

Sparingly among juniper scrub on steep hillsides. Khangsar, 15,000 ft., 24, 27 and 29-7-50.

14. **Aulocera brahminoides** Moore.

Evans 11.1.

Sparingly on open hillsides among juniper scrub. Khangsar, 14,500 ft. and Marsiandi Valley, 12,000 ft., 27 and 30-7-50.

15. **Callerebia scanda optima** Walk.

Evans 13.5.

Field on the edge of forest. Thonje, 6,700 ft., 30-8-50.

NYMPHALIDAE

16. **Vanessa kashmirensis aësis** Fruh.

Evans 36.10.

Sparingly between 12,000 and 15,000 ft., all specimens much worn. Jargeng Khola, 14,500 ft., 2-7-50; Khangsar, 14,500 ft., 27-7-50. Also in June.

17. **Argynnis childreni** Grey f. typ.

Evans 39.2.

Frequent in mixed forest. Marsiyandi Valley, 9,000 ft., 31-8-50.

18. **Argynnis lathonia issaea** Moore.

Evans 39.8.

Fairly frequent. Marsiyandi Valley, 8,200 ft., 25-5-50 and Khangsar, 14,500 ft., 24-7-50 and 13,500 ft., 10-9-50.

19. **Argynnis eugenia** Eversm.

Evans 39.11.

Fairly frequent. Khangsar, 14,500 ft., 24-7-50 and 16,000 ft., 29-7-50.

20. **Melitaea arcesia irma** Higgins.

Evans 40.5.

Common. Manangbhot, 11,500 to 16,000 ft., at end of July.

LYCAENIDAE

21. **Celastrine hugelii** Moore.

Evans 20.19.

Common. Among bushes at the edge of fields. Thonje, 6,500 ft., 24-5-50 and 30-8-50, and Thangja, 6,700 ft., 20-8-50.

22. **Zizeeria maha** Koll.

Evans 22.2.

Among bushes at edge of fields. Thonje, 6,700 ft., 30-8-50.

23. **Albulina near pheretes** Hubn.

Evans ?

Common in grassy places. Manangbhot, 12,500 to 16,000 ft., July.

24. **Polyommatus stoliczkana** Feld.

Evans 24.2.

Common in grassy places and among junipers. Manangbhot, 11,500 to 15,000 ft., July.

25. **Lyceana phleas** Linn.

Evans 35.2.

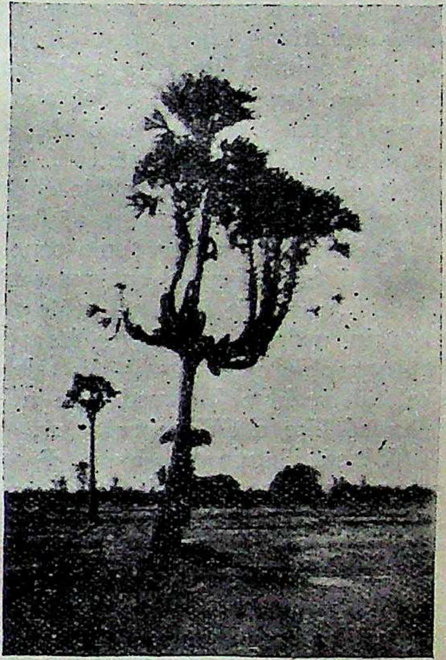
Common locally in grassy places. Manangbhot, 12,500 to 14,000 ft., July.

GADDEN'S CLOSE,
RINGWOOD, HANTS,
ENGLAND,
March 15, 1953.

D. G. LOWNDES,
Colonel.

32. A UNIQUE CASE OF A PROFUSELY BRANCHED PALMYRA PALM

(*With a photo*)



The tree photographed is an interesting case of palmyra palm (*Borassus flabellifer*) growing near Tavabaconpour (Pondicherry). The tree is profusely branched distally, having about a dozen branches each with its own crown of leaves. The crowns of leaves are normal in all respects. In six of them the growth of leaves is, however, as vigorous as in adult trees. Compare the crown of leaves of the branched tree with that of the tree in the background of the photograph.

It appears that the branched condition is due to damage of the apical portion of the tree in an earlier stage of its life history.

I am thankful to Mr. Abel Clovis (Judge, Pondicherry) for the photograph.

Department of Botany,
Annamalai University,
Annamalainagar,
March 23, 1953.

T. C. N. SINGH

33. NOTES ON THE PHOTOGRAPHY OF FOSSILS, WITH SPECIAL REFERENCE TO A SPECIMEN OF *INDOBATRACHUS* FROM WORLI HILL, BOMBAY

(*Communicated by Charles McCann, New Zealand*)

(*With a plate*)

This specimen, of a fossil frog from the Inter-Trappean Beds of Worli Hill, Bombay, presents a problem quite commonly met with in the photography of fossils, namely: that of a specimen whose colour matches that of its matrix and which lies in the same plane as the matrix.

The problem of how to separate these two cannot be solved by either of the well-known 'plane-separation' or 'colour-separation' techniques. The former depends on a difference of plane between fossil and matrix, so that light, falling obliquely, creates highlights and shadows. The latter on a difference in colour, or in tone of a colour, that can be exaggerated by an appropriate colour filter.

A close examination of this fossil shows that the skeletal residue does not lie consistently in one plane but has become vertically dislodged in an irregular fashion, so that there are areas where the skeleton, although not actually overlaid by thin films of shale, has, here and there, been pressed more deeply into its matrix. Thus oblique incident light, glancing across the uppermost plane, could not reach these sunken areas and would not, therefore, illuminate the whole of what is visible to the eye. Clearly some method must be found which is independent of both colour and relief, but is able to differentiate between possible differences in the reflection characteristics of the two substances of fossil and matrix.

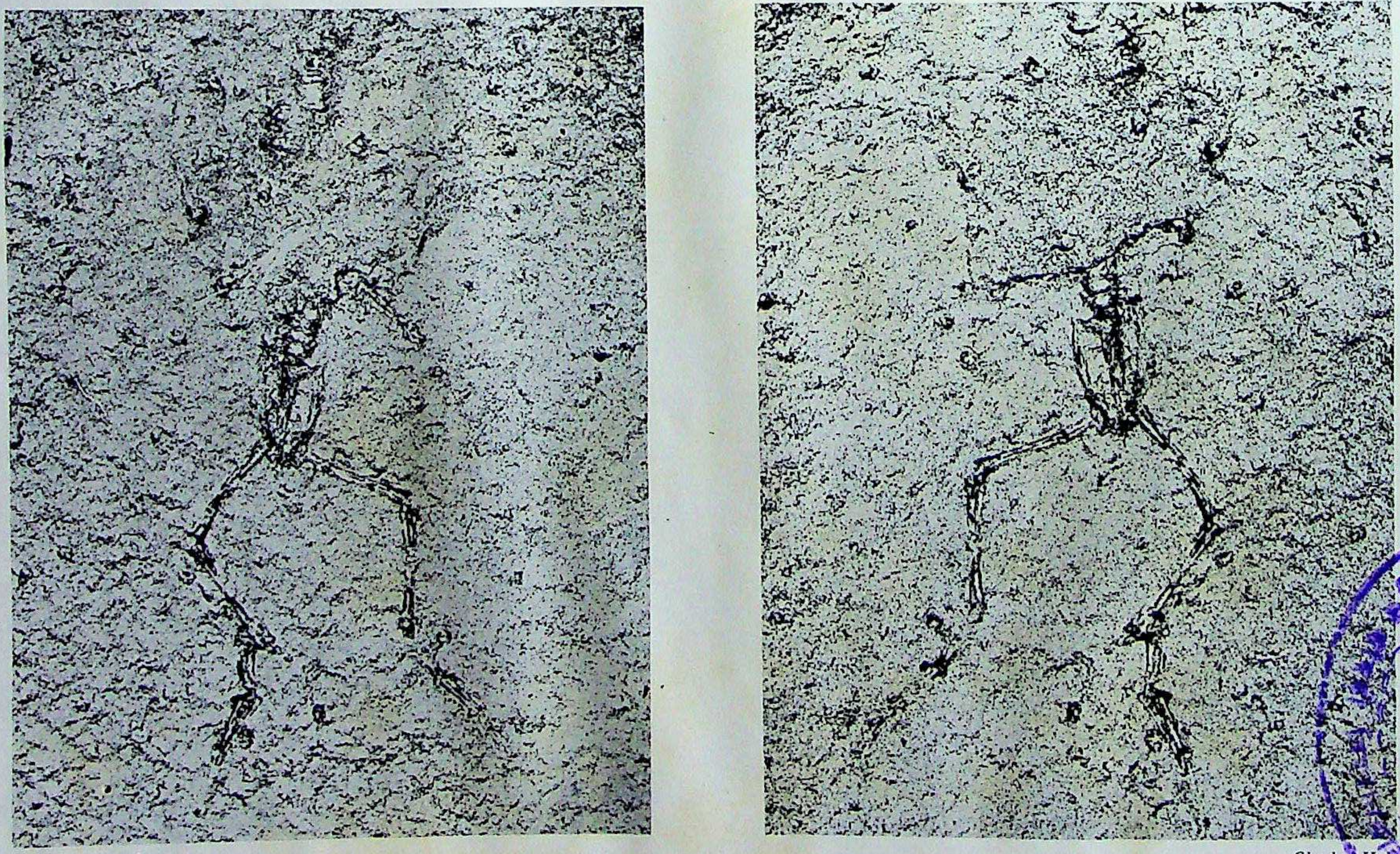
The writer has for some time been using an experimental camera designed for carrying out research on such problems as this. With this apparatus it is practicable to submit a specimen to a series of tests in order to measure its reactions to various illumination and photographic conditions. In this instance it was found that while the skeletal residue behaved like a *regular reflector*, the shale matrix behaved like a *diffuse reflector*.

When illuminated by a directional beam of light from a point source incident upon it at an angle of about 20° from the normal, slight polarisation was noticed. When the collimated beam itself was polarised the effect was increased. With incident light at 0° the effect decreased, and appeared to reach a maximum at 10°—at which the photographs were taken. The process of separation thus started by optical means, it was a matter only of commonplace dark-room practice to continue it further to a point at which maximum contrast was achieved without loss of detail.

The illustrations show how the dark grey shale was raised in tone relatively to the carbonaceous matter of the skeletal residue. In these 'translations' of the specimen it is important to note how the outside edges of the bones have registered as thin black lines, while the interior surfaces register white. None of the black in these pictures is shadow, but arises from the angle at which a regularly reflecting surface reflects light—the light is reflected away from the lens by the curvature of the surface. On the other hand, interior surface areas are normal to the light and reflect back an image of the light source—mirrorwise.

Between the outer edge of the bone and the central surface area is an intermediate area of graded tones. These have almost disappeared from the present pictures owing to the contrast having been exaggerated for reasons already given. This has led to an increase in width of the black outlines and an even greater increase in area of the white portions. Fortunately this does not affect the accuracy of the lineal representation, since the thickening takes place in one direction only—towards the centre—leaving the outer edge of each black line as in nature.

From the spreading of the white outwards a certain amount of information can be gathered about the spherical contour of the bone. A relatively wide white band indicates that a relatively wide area of



Charles Hal

Indobatrachus sp. from the Inter-Trappean Beds of Worli Hill, Bombay. Specimen collected by Charles McCann.

पुस्तकालय
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central surface is normal to the lens, in short, that a section of the bone at that point would be more elliptical than circular. Conversely, a very thin white line would suggest a raised knife-like edge. But in drawing these conclusions due allowance must be made for tonal distortions, for the angle of incident light, the diffuseness of the light and for the size of the light source.

In summarising, it may be said that in the photography of certain types of fossils greater clarity may often be obtained by utilising the diversity of reflection characteristics of fossil and matrix and so bring about, in the first place by optical means and then by controlled processing techniques, a separation of the two that will enable printable illustrations to be made. At very small angles of incident light where no shadows are thrown the photographic image often reveals structural characters not evident in pictures taken by more oblique light.

DOMINION MUSEUM,
WELLINGTON, CHARLES HALE
NEW ZEALAND,
May 5, 1953.

34. COMMENT ON 'THE *MANI-JAL* OF THE CHILKA LAKE—A SPECIAL NET FOR BELONIFORM FISHES'

Dr. S. Jones and Mr. K. H. Sujansingani in their note published in Vol. 50 (1) (pp. 287-288), have stated that *Mani-Jal* is a novel type of net used only in the Chilka Lake and that existing records on fishing methods in India and elsewhere in the world do not contain any reference to this type of net.

Probably, the authors have not referred to Hornell's Fishing Methods, Part I, published in the Administrative Report for 1922-1923, Madras Bulletin No. 18, wherein he has described the same net under the name 'Kuzhi Valai' used in the Negapatam backwaters. He has also stated that it is exclusively used for catching the gar-fish, *Belone strongylurus*. So there is no reason to believe as the authors say 'this net has not been introduced from elsewhere but has had its origin in this section (Balugan) of the Chilka region itself'.

BALUGAN,
May 28, 1953. M. PETER DEVASUNDARAM

35. GLEANINGS

Virus disease wins Pastures from Rabbits

'Australia's greatest pest, the rabbit, is rapidly being brought under control by the planned introduction by the Commonwealth Scientific and Industrial Research Organization of the disease, myxomatosis.

The disease is spread among rabbits by mosquitoes and, in the last three years, has gained such ground that the Lands Department of Victoria now estimates that more than 90 per cent of the rabbits have been destroyed in large areas of the State. Similar destruction is reported from many parts of New South Wales, South Australia and Queensland, with the result that farmers and graziers report a phenomenal increase in the carrying capacity of their pastures.

The Minister for External Affairs, Mr. Casey, who is also in charge of the C.S.I.R.O., said that if the gains won at such low cost were maintained, Australia's carrying capacity would increase by the equivalent of 10,000,000 sheep. A Melbourne wool expert has estimated that myxomatosis may have increased the value of this year's wool clip by £20,000,000. However, Mr. Casey warned that in many districts, rabbits were showing increased resistance to the disease and that, in a very few more seasons, myxomatosis might have lost most of its killing power.'

(*A.S.L.O. Newsletter No.* 58.)

(Reproduced from *Science Newsletter* No. 96, dated 4th March 1953, item No. 1506.)

Toads Hibernating under Water

'That frogs usually hibernate in the water of ponds is well-known but there do not appear to be any records in literature that toads have the same habit. The following therefore is of interest.

In 1927 I constructed a concrete lily pond in my garden, 10 ft. by 8 ft., by 2 ft. 9 in. in depth. A layer of sods covered by pea gravel some 6 in. in depth was put in as a foundation for the lilies and this was gradually increased year by year by the influx of dead leaves. Frogs (*Rana temporaria*) spawned in the pond the spring after it was built and a year later toads (*Bufo bufo*) followed suit. In subsequent years both species availed themselves regularly of the accommodation thus provided.

A few years after the pond had been built I decided to fence off a corner in order to grow some Flags (*Iris pseudacorus*). This involved draining the pond and clearing it of the mud at one end. About mid-November the water was siphoned off and as soon as the bottom mud was fully exposed I waded in to clear it from the corner that had been selected. Almost at once a frog was exhumed. It was quite torpid but shewed signs of animation as soon as it had been rinsed in water and placed in my hand. The next few spadefulls revealed more frogs, and then a toad was discovered. It also was torpid but when cleaned and placed in my hand quickly responded to the warmth. Subsequent digging shewed that in about 4 square yards of mud 17 frogs and 5 toads were in hibernation. These were later returned to the pond.

In the following spring both frogs and toads were spawning as usual and they have continued to do so every year since.'—L. F. G. Waddington.

Reproduced from the *British Journal of Herpetology*, Vol. 1, No. 6, p. 112 (May, 1952).

NOTES AND NEWS

A meeting of members and their friends was held on April 15, 1953 to bid farewell to Col. R. W. Burton, who has left India to settle in England. During the 60 odd years during which Col. Burton has been associated with the Bombay Natural History Society (he joined in 1893 and is one of our oldest members) he has shown the most lively interest in its welfare. His name has become a byword in Indian Wild Life Conservation, and particularly since the attainment of our Independence there is no other single person who has done more to focus the attention of governments, both Central and States, and of the press and public, on the parlous condition of our wild life and the urgent need for calling a halt to the wholesale destruction that is rampant on every hand. His persistent hammering on the gravity of the situation was largely responsible for the coming into being of the Indian Wild Life Board with H. H. The Rajpramukh of Mysore as President. The booklet he compiled at the instance of the latter on the Preservation of Wild Life in India, places in readily accessible form the principal contents of all the many important articles and editorials which have been published on the subject in the *Journal* during the last 70 years. The booklet will be a boon to all Wild Life Committees and executives, and of the greatest assistance to them for a proper understanding of the multifarious issues involved in this complex problem. This may be considered Col. Burton's parting gift to India, and every one who values our wild life for the national asset it is, will be grateful to him for the enormous pains that have gone into the preparation of the booklet.

Another benefaction left by Col. Burton to the Society—it is no less—is his admirable general index of the *Journal*. This was originally prepared by him for his own use, of course, but at the Committee's request he has generously permitted us to publish it in commemoration of the completion of the 50th volume. With suitable modifications the index should be of inestimable convenience to all users of the *Journal* in general and to its editors in particular.

All members of the Society will extend to Col. and Mrs. Burton heartiest good wishes in their new domicile, and the editors hope that the unfailing cooperation and encouragement they have always received from Col. Burton may be maintained.

* * *

In the *Journal* (Vol. 49, pp. 815-832) we published the Bombay Wild Animals and Wild Birds Protection Act 1951. This Act came into force on 1st May 1953 and as detailed rules have been framed thereunder, the gist of what one may and may not do is given below for the benefit and convenience of sportsmen.

1. It is essential that all persons holding a licence under the Indian Arms Act 1878 register all their weapons on payment of Rs. 2 each, with the Wild Life Preservation Officer, The Commissioner of Police in Bombay or the District Magistrate in the districts. This will be in addition to the ordinary arms license fee.

2. Except in defence of life or property you cannot shoot *any* bird or animal unless you possess a game licence which is of three kinds—Small Game, Big Game and Special Big Game.

The following is entirely **prohibited**:—

Shooting of any game during the close season.

Shooting or snaring the Great Indian Bustard throughout the year.

Shooting sambar and chital except males with horns 30″ and 20″ respectively.

Shooting bison and elephant with a rifle of smaller bore than 400 H.V. or 500 Black Powder except a H.V. Magnum 375.

Shooting game on private land except with the permission of the owner.

(The distinction between Forest, malki and other lands is eliminated and the game licences cover the whole of the State. The game blocks in the southern part of the State will be maintained, and will require separate booking).

Shooting in areas declared as sanctuaries.

Shooting from motor cars (also other vehicles) either by day or night.

Use of artificial lights except for carnivora over natural kills.

Shooting during the hours of night, i.e. one hour after sunset and one hour before sunrise, except over natural kills.

Shooting any birds or animals at or on their way to a salt lick or water-hole (except sandgrouse or water birds).

Use of slugs out of a gun against deer, gazelle or antelope.

Buying, selling or offering for sale of meat or any other part of a wild bird or animal.

Shooting any immature bird or animal, or of one accompanied by its young.

Considering the important part the Society played in bringing into being the present Act and Rules, it is expected that its members will extend exemplary cooperation to the State Wild Life Department.

पुस्तकालय
गुरुकुल कांगड़ी

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Contributors of scientific articles are requested to assist the editors by observing the following instructions:

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2. The MS should preferably be typed (double spacing) on one side of a sheet only, and the sheets properly numbered.

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5. Photographs for reproduction must be clear and show good contrast. Prints must be of a size not smaller than 3¼ × 2¼ inches (No. 2 Brownie) and on glossy glazed paper.

6. Text figures, line drawings and maps should be in Indian ink, preferably on Bristol board.

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9. *Synopsis*: As recommended by the Royal Society Scientific Information Conference (July 1948), the editors consider it desirable that each scientific paper be accompanied by a synopsis appearing at the beginning, immediately after the title. The synopsis should be factual. It should convey briefly the content of the paper; draw attention to all new information and to the author's main conclusions. It should also indicate newly observed facts, the method and conclusions of an experiment, and if possible the essential points of any new finding, theory or technique. It should be concise and normally not exceed 200 words.

When the synopsis is complete it should be carefully revised by the author to clarify obscurities, and further compressed wherever possible without detracting from its usefulness.

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